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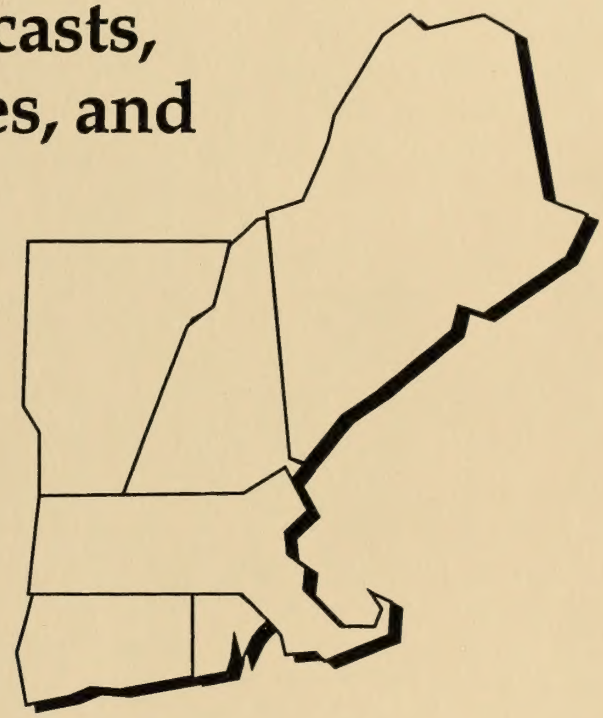
April 1994

NEW ENGLAND TRANSPORTATION INITIATIVE

DRAFT

Transportation Forecasts, Goals and Objectives, and Issues of Regional Significance



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New England Transportation Initiative

Draft

Transportation Forecasts, Goals and Objectives, and Issues of Regional Significance

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Introduction

This is the second draft report of the New England Transportation Initiative (NETI) Project. NETI is a cooperative transportation planning study sponsored by the six New England states. This report proposes the goals and objectives of the study; issues of regional significance to be addressed; and forecasts of future conditions. It builds on the work presented in the Inventory Draft Report and comments received from the Policy Committee and the New England Regional Technical Advisory Committee (NERTAC). Two additional draft reports are to follow: Alternative Scenario Definition and Policy and Technical Analysis.

The first part of this report recommends the goals and objectives of the NETI project. This defines the overriding focus of study. The second part, issues of regional significance, identifies the key issues in each mode or subject which should be the focus of NETI analysis within the context of the goals and objectives. Given the limited resources of the NETI study, it is critical that the project be focused in this manner before additional analysis proceeds.

The third part takes the data gathered in the inventory task and attempts to forecast future trends. This will serve as the basis for Task 6 – the development of three alternative scenarios. It should be stressed that these forecasts are intended only to provide an empirical basis for the development of the scenarios, and do not constitute the scenarios themselves. In particular, the forecasts are primarily modal-based with, however, considerable discussion of overlapping issues. The scenarios will take a broader intermodal look at the future, and more fully consider the interplay between transportation, economic and environmental policies.

The report has been divided into two documents. An Executive Summary presents the goals and objective, issues of regional significance, and the Executive Summary of the Forecast Report. The text of the Forecast Report is contained in a separate document.

The forecasts are based on existing forecast data published elsewhere, modified and adjusted to reflect the context of the NETI study where appropriate. Since most transportation forecasts, at least until recently, were made primarily on a modal specific basis, it was most logical and cost-effective to organize this report along modal lines as was done with the Inventory Report. Independent travel demand modeling is not included in the NETI Scope of Work.

The need to organize the report in this manner should not be construed as an acceptance by the NETI Project of a future like the past, in which transportation investment decisions are made on a modal specific basis. To the contrary, NETI is committed to advancing the implementation of the ISTEA agenda for intermodalism. This will clearly be reflected in subsequent tasks, and is reflected in the text of this report (see following discussion).

High and low forecasts are provided for each mode as outer frameworks for the development of the Alternative Scenarios. Forecast years are primarily 2000 or 2010 because this corresponds to the majority of existing data. It is only relatively recently that transportation projects have begun forecasting to the year 2020. However, much of the economic data does extend out to 2020. This will not prevent the project from extrapolating forecast transportation trends to the year 2020, at least in a qualitative sense, in the development of the Alternative Scenarios. In some unique cases, the forecasts actually focus on the recent past. For example, future ozone levels are mandated by the attainment requirements of the Clean Air Act Amendments. Therefore, the report looks at recent trends in ozone concentrations in the context of changes in travel behavior and vehicle technology.

The Role of Intermodalism; Economic and Environmental Issues

This report begins the NETI process of considering transportation issues across modal lines, and in the context of the need for transportation investment to serve the goals of economic development and environmental protection. Although the report is organized along modal or issue lines, there is substantial discussion of intermodal issues within the text of the chapters. Examples include the following:

- The highway chapter includes a high and low forecast. The high forecast is based on the official State Implementation Plans (SIPs) for Air Quality. The low forecasts were developed by this study based on the forecasts for economic growth included in the economics chapter. These forecasts can also be used to represent a future in which the growth of highway-related travel is constrained by public policy.

- The railroad and port chapters both reflect the mutual interrelationship of these modes in that the future of rail freight transportation in New England is closely related to the "land bridge" concept providing for the transfer of waterborne containerized cargo to railheads at the ports. The success of this concept is dependent both on macroeconomic trends in the shipping industry (which individual states and railroads have limited ability to impact), the quality of port facilities, and the provision of double-stack clearances on rail lines. The latter issue in turn impacts highway policy since in many instances rail clearances are constrained by highway bridges.

- The airport chapter provides high and low forecasts. The high forecasts are based on official FAA projections. The low forecasts are based on the economic forecasts provided in the economics chapter adjusted for the impact of high speed ground transportation implementation in selected markets.

- The trends in commuter behavior chapter discusses how major demographic changes in American society over the past two decades resulted in dramatic increases in single-occupant automobile travel, and how emerging technological developments today, such as telecommuting, could potentially have the opposite effect in the coming decades if properly nurtured by public policies.

- The economics chapter discusses New England's economic future, specifically in the context of how the transportation system needs to respond to new economic patterns. Examples include the shift from heavy manufacturing to smaller, more decentralized, "lighter" industrial products with "just-in-time" delivery requirements; the continued need to respond to the growing tourist industry via more effective external connections and better local access to key sites which experience high seasonal peaking demand;

and the need to meet the needs of new cluster industries such as biotechnology which have the potential to provide high wage jobs.

- Given limited resources, the study has chosen to focus on a small number of critical environmental issues which most interact with transportation planning on a regional scale. These issues include air quality, land use planning, aesthetics and quality of life, and water quality.

Part I. Goals and Objectives

I. Goals and Objectives

The overriding goal of the NETI process is to develop a Plan of Cooperation among the six New England states. This Plan is intended to develop a framework for regional cooperation and decision making in the transportation sector, but will not by itself constitute a formal transportation investment plan. It will, however, identify issues where potential regional consensus for action exists as well as critical areas where consensus does not today exist. In doing so, the plan will articulate a process for identifying and resolving those situations where consensus does not exist.

Beneath this goal, there are many objectives which need to be reflected in the Plan of Cooperation. Nine objectives are highlighted below. The order of discussion does not imply priority.

1. **Minimize Intra-Regional Competition** – Transportation investment decision making is largely made today at the state rather than regional level in New England. This can result in a short-term strategy to maximize peripheral state advantages at the expense of the long-term advancement of the region. It is perhaps most acutely reflected in decision making regarding the development of point-specific facilities like ports and airports. Clearly, some competition within the New England region is desirable and results in superior service and options for consumers. The NETI objective should be to develop a process for identifying and resolving those situations which result in a positive competitive environment and those which are wasteful of the region's limited resources.

2. **Use Transportation Investment to Promote Economic Vitality** – The official economic forecasts for New England presented in the Inventory Report show the region growing more slowly than the nation as a whole over the next 20 years, and more slowly than the experience of the past two decades. Carefully targeted regional transportation investment in both passenger and freight services are seen as a way to boost the growth rate, consistent with other transportation objectives. In particular, transportation investment can be used to support the service sector which is seen as the region's growth engine, while also preserving as much as possible of the traditional manufacturing sector which has survived the shake-out of the last decade. It should be a NETI objective to identify opportunities for targeting transportation investment in a way to maximize regional vitality consistent with overall transportation objectives.

3. **Protect the Environment while Minimizing Regulatory Barriers to Investment** – As an increasingly service-oriented region of the country, environmental and aesthetic values which once seemed like luxuries in a more manufacturing-oriented environment, now form part of the core attraction of the region. Thus, environmental protection is important not only for its own health and aesthetic values, but is essential

to economic growth. Major transportation infrastructure projects inevitably have environmental consequences both good and bad. Yet continued infrastructure investment is also essential for economic growth. The NETI project should have as an objective the development of a strategy for ensuring that transportation investment protect and enhance environmental values, and that in doing so the regulatory process does not inordinately delay or hinder necessary investments which meet reasonable criteria. Of particular importance in today's policy environment is the need to develop strategies that will assist states in complying with the Clean Air Act and demonstrating conformity between their transportation and air quality plans; land use planning and its interrelationship with the transportation system; the importance of maintaining aesthetic values and the New England quality of life; and the protection of water resources.

4. **Use Technological Advances to the Maximum Extent Possible** – For an entire era beginning with the Interstate Highway program in the mid-1950s, the most frequent solution to inadequate capacity in the transportation sector was to build or expand physical facilities – usually highways. This approach was modified in the 1970s to also include consideration of alternative investment strategies such as public transportation. Expansion of physical facilities in New England is increasingly problematic due to financial constraints, the high density of development particularly in southern New England, physical barriers particularly in northern New England, and the need to preserve remaining open space and environmental features such as wetlands. These factors have become equally significant in planning highway and non-highway facilities. The explosion of new transportation technologies, including but not limited to the range of concepts identified under the umbrella term of Intelligent Vehicle Highway Systems (IVHS), and the potential for reducing vehicular emissions and energy consumption, offers new opportunities to expand capacity by making more efficient use of existing facilities or to reduce the negative impacts of congestion. It should be an objective of the NETI study to develop strategies for facilitating the implementation of technological solutions to capacity limitations.

5. **Use Changes in Social and Work Patterns to Minimize Travel Demand Growth** – The alternative approach to addressing capacity limitations in the transportation system is to reduce or change demand characteristics. Macro-level changes in American society can impact demand in both directions. For example, positive changes such as the dramatic increases in female participation in the work force along with other developments such as an increase in the number of single-parent households in the last generation resulted in travel demand increases which outstripped the increase in population and employment growth. But this change has largely made its way through the system. Different trends in the next generation could have the opposite effect; these changes are focused around the changing nature of work itself including telecommunications, flextime, part-time work and self-employment. It should be an objective of the NETI study to develop strategies for encouraging these trends and using them to reduce the need for increasing the capacity of transportation systems.

6. **Coordinate Land Use and Transportation Planning** – There has long been tension in U.S. policy making between the many public policy factors and personal preferences

which encourage the suburban sprawl style of development, and the strains which this trend places on the transportation infrastructure. To some extent, New England is better off in this regard than other regions of the country due to its compact physical geography and the continued existence and prosperity of many traditional city and town centers. Nevertheless, New England has experienced VMT growth over the past generation due to the increasing separation of residential, employment, recreational, and shopping functions. Many such trips increasingly cross state boundaries. Given that New England is a relatively settled area with low population growth, the potential for modifying this pattern exists only at the margins. Nevertheless, it should be an objective of the NETI project to develop a strategy for encouraging changes in land use planning so that development patterns do not continue to foster automobile dependence and congestion.

7. **Promote Intermodalism** – Traditionally, transportation planning in the United States was done on a modal specific basis. This tendency is reinforced by the organizational structure of transportation decision making at the state and federal levels. Increasingly, trips require the use of more than one mode and it is at the interface between modes where effectiveness is lost. Intermodal connections in freight shipments, particularly between ports and rail facilities, is increasingly critical in maintaining a competitive economic environment. Intermodalism is an explicit goal of the federal ISTEA legislation, and the development of intermodal strategies and institutional arrangements should be an objective of the NETI project.

8. **Promote Innovative and Fiscally Sound Financing Policies** – The major transportation investments of the last generation, and frequently throughout American history, have been driven by federal policy and money. Clearly, we are in a different environment today in which federal resources are limited and decentralized decision making is valued. It should be the objective of the NETI project to promote financing strategies which incorporate private sector participation, use innovative approaches, and accurately reflect the costs and benefits of the investment options available.

9. **Intra- and Interregional Connectivity** – The transportation network should provide efficient and effective connections for New England freight and passenger services to the rest of the nation and international destinations, and within New England including between southern and northern New England and between rural and urban areas.

Part II. Issues of Regional Significance

II. Issues of Regional Significance

The following issues are proposed for consideration or mention in the NETI study as being of regional significance. In a number of cases, issues are mentioned as potentially being of regional significance, but the resources do not exist to thoroughly examine them as part of this study. These include pipelines and local/commuter-oriented water passenger services.

■ 1.0 Institutional and Organizational

The focus of this subject is on issues which override the concerns of individual modes (with the exception of environmental issues which are treated separately), the decision-making process itself and the extent to which it fosters regional cooperation, and issues which transcend the New England region.

1. The planned development of a National Transportation System (NTS) as a logical intermodal extension of the proposed National Highway System (NHS) offers a unique opportunity for NETI to contribute to the development of an integrated regional intermodal transportation system.

2. Public/private partnerships present an opportunity for creative approaches to solving transportation problems in an era of constrained government finances. Care must be taken to ensure that appropriate public purposes are achieved where mixed financing occurs.

3. The ways in which government finances transportation projects, and the implicit subsidies to different modes inherent in these approaches, needs reexamination in light of constrained government finances, the priority given to intermodalism, and the impact of changing travel patterns and technology on the traditional user fee-based financing mechanisms such as the gasoline tax. There is a need to broaden the user base to charge equitably for all movement of people and goods.

4. The I-95 Coalition consisting of the East Coast corridor states from Virginia north provides one opportunity among many for an interregional approach to the implementation of Intelligent Vehicle Highway Systems (IVHS).

5. All of the states are struggling with developing and implementing methodologies for meeting the new federal ISTEA planning regulations. NETI can help to foster a common approach and the development of more advanced methodologies.

6. There is a need for better freight data to facilitate regional planning and coordination.

2.0 Highways

The focus of this effort is the National Highway System (NHS) as currently proposed by U.S. DOT, plus some minor adjustments requested by the states.

1. Maintain in good working order the existing roadway infrastructure.

2. Develop strategies for meeting capacity limitations through means additional to the expansion of Single Occupant Vehicle (SOV) capacity; strategies include development of High Occupant Vehicle (HOV) facilities; operational improvements via new technologies; and Transportation Demand Management (TDM). The purpose should be to meet capacity requirements while maintaining or reducing total vehicle emissions during critical periods.

3. Identify those situations requiring capacity expansion programs.

4. The majority of freight traffic in New England is carried by motor carriers. The industry faces a range of pressures including competition within and outside the industry; increasing emphasis on "just-in-time" delivery, and increasing highway congestion, New England needs to develop a consistent approach to commercial vehicle regulation which will minimize regulatory barriers and inefficiencies between states, and incorporate commercial vehicle operational issues into IVHS planning. Their needs to be done in a way which preserves the critical role played by the motor carrier industry in the New England economy while being sensitive to environmental values.

5. Develop strategies for maintaining essential intercity bus services to rural areas; enhance intercity bus commuter services to urban areas in conjunction with the development of HOV facilities; and provide better scheduling coordination with urban transit services and other modes.

6. As endorsed by AASHTO, highway design standards should be reviewed with the goal of providing more flexible standards which can conform to unique regional characteristics and physical constraints, while still providing for safe operation.

3.0 Railroads

The focus is on the seven first-tier carriers – Amtrak, Conrail, Guilford Transportation Industries, Canadian Pacific, Central Vermont, Providence and Worcester, and Bangor and Aroostook. Other issues and facilities will be considered on a consolidated state-by-state basis.

1. Maintain and enhance Northeast Corridor main line passenger and freight transportation service.

2. The role of railroads in providing a land bridge between seaport connections is a major issue affecting the future role of both New England port and rail freight facilities. This will likely require providing double-stack clearances over railroad tracks on some routes, which will impact highway programs as well. Market forces affecting the shipping industry will have a major impact on the growth of demand for these facilities; examples include the preference of the automobile industry to concentrate shipments at a small number of major centers, and the increasing growth of the Southwest Asian market with a shipping orientation through the Suez Canal to East Coast ports.

3. In addition to the intermodal market for railroad freight service, another potential growth market which has been identified is the shipment of waste material. With the closure of local landfills, there are growing opportunities for longer distance (i.e., railroad competitive) movements to reclamation or disposal sites. In New England, the waste paper industry may be a potential major component of this market.

4. There is considerable interest in the expansion of commuter rail services, many of which serve more than one state. Financing is a particularly critical issue, as is the sharing of facilities also used by intercity passenger and freight services.

5. There are many projects and studies underway for the implementation of interstate high speed ground transportation facilities in the Boston-New York-Washington-Portland corridor and Boston-Albany corridor. The interrelationship of these services with commuter air service and interstate auto travel is critical in determining an appropriate investment strategy for the region.

6. Many rail facilities in New England still face the threat of abandonment. These facilities often provide the only rail service to existing manufacturing operations. The development of an abandonment strategy and identification of a core New England rail network worth preserving is an issue of regional significance.

7. The provision of an interconnected passenger rail system within New England and between New England and the larger Amtrak system is of regional significance. The North Station to South Station rail connector proposed by the Commonwealth of Massachusetts for the Central Artery corridor in Boston is an example of a project which could help to achieve this goal, as is the rehabilitation of the Concord-White River Junction line for access between Boston and Montreal.

8. A new cross-Hudson rail freight connection is of regional significance in the maintenance of a viable New England rail freight service integrated with national service.

9. Railroad jurisdiction and interlining problems are a major issue.

10. The ISTEA prohibition on the use of FHWA funds for a variety of rail freight improvements is a regional issue.

4.0 Airports

The focus of the study will be on the top seven airports in annual enplanements which account for 95 percent of all New England enplanements. These are the airports serving Boston, Hartford, Providence, Portland, Bangor, Burlington, and Manchester. In addition, Worcester and Pease are aspiring to play regional roles and should therefore be included. Other public and general aviation facilities will be considered on a consolidated state by state basis.

1. Ground access to airports is a critical intermodal issue which is a major factor in the potential regional role which an airport can play. This issue is most critical today at Logan Airport. A related issue is the prohibition on the use of passenger facility charges for ground transportation services indirectly related to airport operations.

2. The growth of airport demand is inversely related to the development of high speed ground transportation services, which will in turn impact the capacity requirements of some New England airports in the future.

3. The development of a regional air transportation system, which may or may not involve a single second major regional airport or a system of smaller regional airports, is clearly of regional significance. Related to this issue is commuter access to Logan Airport from smaller New England airports for access to national and international long-haul service.

4. Bradley International Airport in Windsor Locks, Connecticut is an under-utilized facility which represents the second largest airport in the region with twice as many annual enplanements as the next busiest facilities (Bangor and Providence) and four times as many as any other facility. Maximizing its potential role in the regional air transportation system is an important issue.

5. The route and fare structures available to New England residents and businesses affect issues of economic growth and consumer choice. The airport surveys conducted in the inventory phase indicated relative satisfaction with the route system but some concern with fare structure. The latter could be improved through the development of low cost carriers serving short-haul markets. While the growth of such carriers is primarily market-driven, New England needs to position itself through a regional air transportation strategy to take maximum advantage of such developments.

6. The impact of industry-wide market trends such as larger aircraft serving major hubs and smaller aircraft serving other destinations, the decline of general aviation, reduction in industry operating costs, the growth of commuter and international

traffic, and FAA technology improvements in Air Traffic Control (ATC) will impact New England decisions regarding airport capacity.

7. Funding of capital improvement projects and operating subsidies are key concerns for airports, in particular the uncertain future of the Airport Improvement Program (AIP) and the Essential Air Service (EAS) Program.

5.0 Ports

The focus is on 12 ports of which nine are among the top U.S. 150 in cargo tonnage. These nine ports are Boston, Fall River, Portland, Searsport, Portsmouth, Providence, New Haven, New London, and Bridgeport. In addition, the ports of Davisville (RI) and Eastport (ME) have been identified by their states as being regionally significant. Finally, New Bedford services two important niche markets for the export of fresh seafood and the importation of fresh fruit.

1. As identified above, intermodal rail connections are critical to the future of New England ports.

2. The ability to expand port capacity is impacted by environmental controversies over harbor dredging.

3. New international trade agreements, and market trends in the shipping industry, will have major impacts on the development of port strategies.

4. The vast majority of cargo (82 percent) which passes through New England ports are imported petroleum products. While this market may slowly decline due to greater reliance on cleaner burning fuels and the introduction of more energy efficient vehicles individual markets remain strong. The future of the ports is really dependent on what happens with the other 18 percent of cargo, and this will be the focus of NETI. Of this 18 percent, the key elements are those cargos which are competitive in nature and can readily shift among ports as compared to those which are largely dependent on a local hinterland market.

5. In addition to gross tonnage, passenger volume and the dollar value of cargo should also be considered in evaluating the role of New England ports.

6. Water passenger services should be encouraged for their role in enhancing local tourist markets and providing essential transportation connections.

7. Pipelines should be viewed as a potential alternative to traditional ground transportation services as a means of distributing liquid bulk cargo from ports to end users.

8. The development of a regional port strategy which focuses on maximizing New England port activity vis-a-vis other regions and modes rather than on intraregional competition, is a critical NETI issue.

6.0 Trends in Commuter Behavior

Changing demographic patterns, in combination with specific work-related trends which can be encouraged as a matter of public policy such as telecommuting and other flexible work arrangements, has the potential to significantly impact regional travel growth in positive ways so as to reduce congestion and hence the need for future capacity expansion projects.

7.0 Economics

The overriding issue is how to use transportation investment to make New England's manufacturing core industries more productive and competitive and promote the development of the service sector. Specific issues include the following:

1. A more efficient and time-sensitive transportation system is desirable to meet the "just-in-time" delivery requirements of the manufacturers of high tech and other smaller, lighter goods which are increasingly replacing the traditional heavy industry manufacturing base.

2. Better external connections are required to take advantage of export opportunities generated by the changing international trade climate, the continued increase in tourist traffic into the region, and increases in frequent business travel into and out of the region.

3. The increase in tourist traffic also drives the need for improvements to local access facilities which may experience severe seasonal peaking requirements.

4. The development of new internal "cluster" industries, such as biotechnology, requires improved intraregional transportation systems.

5. The continued growth in population, employment, and economic activity, though projected to be slower than during the past two decades in New England and slower than for the nation as a whole over the next two decades, will nevertheless substantially increase demand for transportation services. The greatest numerical increases will occur in southern New England where transportation systems are today

the most congested. The greatest proportional increases will occur in northern New England where facilities are in general less congested but also less robust.

8.0 Air Quality and Energy

1. The critical pollutant of regional significance is ozone since its concentration is impacted by transport over wide areas, and it represents the most serious non-attainment problem in New England.

2. NETI will aim to assist in the development of a regional strategy for meeting CAAA ozone standards, for helping to demonstrate conformity of transportation and air quality plans, and for the development of a regional analytical methodology to document compliance. Since ozone non-attainment is primarily a summer phenomenon, strategies should target both permanent, long-term travel characteristics and unique seasonal travel characteristics.

3. NETI will assist in the development of a regional clean and alternative vehicle fuel program which meets the requirements of both CAAA and EPA, is acceptable to industry, and for which an infrastructure of critical mass can be created.

4. The appropriate role of transportation, stationary and other sources of pollution in solving air quality problems needs to be addressed in evaluating the interdependence of ISTEA and CAAA.

5. In the past decade, gains in vehicle energy efficiency have been offset by increases in vehicle miles traveled, with transportation-related uses consuming more oil than is produced in the United States. Development of a regional clean and alternative vehicle fuel program, as mentioned above, would not only serve to meet transportation and air quality plans, but would reduce the region's dependence on unreliable foreign oil.

9.0 Other Environmental Issues

The following issues were discussed in the Inventory Report: wetlands/waterways, parklands and historic resources, hazardous material, noise, broad-based environmental regulation, land use planning, and aesthetics and quality of life issues.

1. Many of the areas examined in the Inventory Report are relatively settled matters of law on which the NETI project could have minimal impact.

2. Wetland and waterways protection remains an issue of regional significance given its broad impact on transportation investment decision making and the likelihood of ever more stringent public policies. Related issues include stormwater run-off into sensitive waterways and the pending reauthorization of the Clean Water Act.

3. Land use planning provides a major policy opportunity for shaping future transportation investment decisions in ways that can minimize growth in VMT and unnecessary SOV trips and promote more efficient freight movement, and thus assist in achieving compliance with CAAA mandates. Transportation decisions could potentially help to develop new land use patterns, while being sensitive to patterns which may want to emerge for other reasons. Transportation planning has the potential to promote regional considerations, which in turn could promote a different pattern of land use development.

4. Aesthetics and quality of life issues are increasingly critical in transportation decision making as New England continues its transformation from a manufacturing to a service-based economy. This includes those characteristics which help to define the New England environment for residents and visitors, including personal mobility; rural, suburban and urban lifestyles; traditional town centers; rural vistas; historic places; and recreational facilities.

Part III. Forecasts/Trends Assessment

III. Forecasts/Trends Assessment

This section of the report addresses the major trends in each of the NETI subject areas. It is organized in the same way as the Inventory Report. Where possible, quantitative trends have been identified. However, given the broad-based nature of the NETI study, a certain amount of qualitative assessment is necessary.

For a complete understanding of the forecasts, the reader may want to refer back to the corresponding chapter in the Inventory Report to reference existing conditions data. In order to keep the size of this report manageable, such references have been minimized in this report. However, base conditions are reiterated in certain chapters, such as Highways, since the base volume to capacity data was not available for all states at the time of publication of the Inventory Report.

While there is no formal forecast year for the NETI project, forecast data in this report is generally focused on the years 2000 and/or 2010. The emphasis varies from mode to mode, and even within modes, depending on the availability of regionally-based data. When possible, forecasts are based on existing planning documents. In other cases, forecasts are based on assumptions about New England economic growth as outlined in Chapter 7.0 of this report and the Inventory Report, modified where appropriate by conditions and opportunities unique to the mode or local area. In such cases, high and low forecasts are often provided.

These forecasts will serve as the basis for the development of the three alternative scenarios in NETI Task 6.

1.0 *Institutional and Organizational*

1.0 Institutional and Organizational

1.1 Strategies for Innovative Organizational and Institutional Approaches to Achieve Regional Goals

1.1.1 The Issues

The six state DOTs recognize that there are many common transportation issues and concerns that can and should be addressed in a more cooperative, unified way than has occurred in the past. However, even within individual states, there is often an absence of unified action on issues of common concern.

This is not an unusual problem, or one that is unique to New England. For many years state DOTs throughout the nation have attempted to develop and implement fully coordinated programs to address common concerns. But, they have frequently been hampered in doing so because of institutional and organizational barriers that are difficult to overcome.

As an illustration of the above, reference is made to "A Committee Report of the Highway Special Committee on Transportation System Operations" (prepared by T.F. Humphrey, for the American Association of State Highway and Transportation Officials), March 1992. That report was based upon the collection of data and analysis of the issues that have constrained state DOTs in their efforts to fully develop and implement multimodal transportation systems' operational improvements. The report emphasizes that institutional and organizational barriers and complexities are among the overriding constraints that inhibit every state from effectively implementing even well-known operational improvements, such as comprehensive incident management programs.

The report cites several common institutional barriers that exist. These include:

- Outdated procurement regulations;
- Outdated statutes;
- Traditional procedures or lack of procedures;
- Bureaucracies;
- Entrenchment;
- Shifting priorities;
- Inadequate technical skills;
- Maintenance requirements;
- Multi-jurisdictional systems;

- Organizational structure; and
- Interagency conflicts.

In addition to the above, there often are overlapping and sometimes competing, organizational structures that complicate the situation. Of obvious importance are the responsibilities of the various organizations that are involved, including federal, state, regional and local levels. There are interagency groups affected, and the private sector is becoming more significantly involved.

One example of these complexities is illustrated by the efforts to develop regional incident management programs, one of the operational methods that can reap enormous benefits.

In any one region, there may be many public and private organizations dealing with operational matters. The development of an incident management system provides a good example. Several state, local and regional agencies may have individual responsibilities for different highway-related systems:

- Interstate;
- Other state highways;
- Parkways;
- Local streets;
- Bridges;
- Tunnels; and
- Toll highways.

In addition, several separate jurisdictions may have individual responsibilities for incident detection, verification and removal, such as:

- State environmental agencies;
- Local environmental agencies;
- State police;
- Local police;
- Fire departments;
- State highway department;
- Local highway departments;
- Federal agencies; and
- Toll authorities.

To further complicate matters, any change in programmatic priorities can cause great disruption within a public agency. There are always debates that occur around the question of "how much money" should be assigned to planning, design, construction, maintenance, and operations.

Further, it is often difficult for public agencies to take risks with regard to the expenditure of public funds. Consequently, it is easier and safer to "go-with-the-traditional" approach than to try something new. This is especially the case when a concept such as "new technology" is proposed as a method to deal with current problems.

1.1.2 Examples of Innovative Organizational Approaches

The most common motivation for several states to cooperate on joint transportation initiatives has been on Commercial Vehicle Operations (CVO). Examples include:

- The New England Transportation Consortium (NETC). Creation of common permitting procedures for oversize/overweight commercial vehicles engaged in interstate travel.

- An expansion of the above referenced NETC initiative to the four AASHTO regions (where progress is being made to implement similar programs).

- The I-75 corridor initiative for CVO operations, stretching from Michigan through the Mississippi Valley to Florida.

- The CRESCENT program extending from Texas to California and north to Washington and British Columbia.

- Several CVO/IVHS initiatives funded by the FHWA (through ISTEA) have included:

  - The Southeastern states;
  - Kansas-Missouri; and
  - Maine-New Hampshire-Vermont.

- The TRANSCOM program is a multi-state incident management initiative which incorporates New York, New Jersey, Connecticut, and Pennsylvania. Its primary focus is on incident management, but other initiatives are also being established.

- The I-95 Corridor Coalition is underway, and it includes all of New England and the states in the I-95 corridor southward to Virginia.

1.1.3 The New England Approach

The New England States have undertaken a few comprehensive and sustained initiatives to deal with common transportation issues. They are summarized below:

1. The New England Transportation Consortium (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont). This program has been a unique and successful example of regional cooperation, dealing with policy and technical matters of common concern. It has resulted in the following accomplishments:

   - Common permitting procedures for oversize/overweight commercial vehicles;

   - Common design standards for crash-tested bridge rails;

- Development of a non-destructive testing method for determining the condition of concrete bridge decks;
- Common design standards for wetlands evaluation in the highway EIS process;
- Development of common truck management procedures;
- Development of a regional rail policy plan;
- Evaluation of the effects of CMA on ground water supplies;
- Common data collection methods to evaluate truck safety issues; and
- The use of tire-chips as backfill.

New NETC projects currently underway include:

- Development of more cost-effective procedures for collecting truck weight and classification data;
- Analysis of bridge construction costs in New England; and
- Design and construction of a prototype retaining wall using tire chips as backfill.

2. The New England Electronic Toll and Advanced Traffic Management (ETTM) Group. This program includes the Turnpike Authorities in Massachusetts, Maine, and New Hampshire. It also includes the Boston Central Artery/Tunnel Project (which will eventually include a toll facility), the Massachusetts Port Authority and Boston region's MBTA. Its purpose is to develop compatible technology standards for ETTM systems.

3. New England's role in the I-95 Corridor Coalition. Based upon current activity, it appears that the most active and sustained participation is by ConnDOT, whose Commissioner is co-chairperson of the Policy Committee.

1.1.4 Organizational/Institutional Strategies to Consider

There are a number of reasons why the six states should be cooperating more effectively and in a more continuing and sustained way in order to take advantage of pooled resources (intellectual, physical, and fiscal) as well as to take advantage of their regional congressional influence in Washington. All of the following issues have been addressed individually by each state in the past and are most likely of current concern. In some cases, some joint actions have occurred. More can be done cooperatively, however, in order to achieve a more effective regional set of accomplishments.

1. Addressing federal planning regulations.
   - ISTEA in general
   - Joint FHWA/FTA planning requirements
   - Other Federal DOT requirements for other modes

2. Addressing federal environmental regulations.
   - CAAA
   - NEPA
   - Wetlands and Waterways
   - Historic/Archaeological Resources
   - Parklands
   - Hazardous Materials

3. Analysis of effective methods to develop transportation mitigation actions to address social and environmental issues, including land use actions.

4. Common regulatory actions to deal with commercial shippers for highway, rail, air, and seaport.

5. The development of regional economic impact and transportation models to analyze alternatives and establish effective regional programs.

6. Analysis, testing, and deployment of technologies such as IVHS systems.

7. Development of common strategies to implement seamless transportation systems for the movement of people and goods by all modes, including intermodal and terminal connections.

8. More effective incorporation of the private sector into strategic regional planning activities (e.g., transportation providers, shippers, carriers).

9. Formation of an effective continuing legislative research capability.

10. The formation of an effective strategic research program to develop new and innovative approaches for dealing with old as well as new problems.

11. Analysis of more advanced and accurate air quality monitoring devices.

12. Formation of appropriate organizational mechanisms to determine how to take advantage of the region's former defense-oriented industries.

13. Developing innovative strategies for raising revenues from a wide variety of sources.

There is currently no organizational structure in place that provides the necessary mechanisms to deal with any of the above. The following alternatives are suggested for further consideration and analysis.

I. Expand upon existing public agency regional organizations, but with a focussed set of objectives. Current existing organizations that might be considered include:

- New England Governor's Conference and Conference of Northeastern Governors (CONEG);
- The Northeast Association of State Transportation Officials (NASTO), perhaps through a "sub-committee" composed of the six New England states;
- The New England Transportation Consortium which has been recently expanded to include Connecticut; and
- The New England ETTM Group which currently incorporates several transportation agencies in addition to most of the state DOTs.

II. Create a new, formal organizational structure that would be composed of the Chief Administrator Officers of the six New England States DOTs.

III. Create a new, formal organizational structure that would incorporate the six state DOTs plus the major transit agencies, toll agencies, and representatives from the private sector and state economic, and environmental agencies.

Major functions to be undertaken by such a regional mechanism would include:

1. Legislative research and analysis.
2. Policy research and analysis.
3. Technical research and analysis.
4. Innovative actions to use transportation as a leverage for economic growth where consistent with other transportation goals.
5. Policy mechanisms for formulating and implementing joint actions.
6. Focus for establishing unified congressional action.
7. Simplification of regulations and statutes to enhance multimodal transportation.
8. Joint demonstration programs, such as how to address commercial vehicle operations, regional incident management programs, etc.
9. The formulation of regional education programs to provide a continuing stream of highly trained professionals.
10. Formal interaction with major transportation employers, shippers, and carriers.
11. Unified approaches for dealing with environmental issues.

1.1.5 Conclusions

While the six New England States will, of course, always retain their individual sovereignty and prerogatives, they can no longer continue to fail to cooperate if the region is to take full advantage of the enormous strengths and talents of the agencies involved. Serious consideration should be given to a more formal organizational structure focused around resolution of common transportation issues.

1.2 Northeast U.S. Issues That Transcend New England

1.2.1 The Issues

There are at least four (but no doubt more) opportunities for collaboration that are described below:

1. The formulation of the New England portion of the "Intermodal National Transportation System."

2. The I-95 Coalition.

3. Improved high speed ground passenger service in the Northeast Corridor.

4. The application of IVHS technologies to Commercial Vehicle Operations.

Environmental issues are discussed in Chapters 8.0 and 9.0. Issues specific to individual modal operation are discussed further in the modal chapters.

1.2.2 The Intermodal National Transportation System (NTS)

The states submitted their proposals for a National Highway System (NHS) to the Federal Highway Administration in the fall of 1993. The FHWA submitted the national program proposal to the U.S. Congress in December 1993, as required by ISTEA. The U.S. DOT and the states view the NHS as the backbone for the eventual identification and selection of a National Transportation System that will connect all modes of transportation.

During the planning stage of the NHS, the six New England states cooperated in establishing highway connections at state boundaries to insure consistency. U.S. DOT is now intent on establishing an Intermodal National Transportation System (NTS). This will be a formidable task, but one which will eventually result in establishing a world class intermodal transportation system that is essential for the nation to compete in the world market place.

The identification and selection of the New England portion of a National Transportation System offers the region an unprecedented opportunity for regional collaboration. However, in order to do so effectively, a more expanded degree of cooperation and interaction will be needed.

Of particular importance is the need to incorporate the talents and resources of the private sector in the process. For freight transportation, a more formal set of relationships must be established with the motor carriers (rail, truck, seaport and air carriers) and the major shippers (those major companies, in particular, which depend upon the efficiency of an intermodal transportation system to get their products to market and their raw materials to their manufacturing sites).

On the passenger side, it is essential to analyze the demand for intermodal connections, in particular for tourists. Easier connections could provide the incentives for more tourists to visit New England year round.

Another important set of participants in such an effort must be the technology leaders in the region. This includes not only its leading universities, but also the private sector companies which are developing and deploying technologies that could have a profound impact on transportation in the 21st Century. For example, the rapid advances in telecommunications and communication technology in general will lead to changes in the way we do business in the very near future. Consequently, companies specializing in communications (e.g., AT&T), computer systems (e.g., Digital), technology hardware development (e.g., Raytheon), and many others need to be involved in this overall effort.

The development of public/private partnerships is important for several reasons. First, there are serious limitations on public resources at both the federal and state levels. States must find new ways to fund and deliver technologies and services. At the same time, there are potentially attractive opportunities to private sector entities with interests in the provision of technology-based services, especially given the multi-state scale of the potential market in New England and beyond.

However, new types of business arrangements between public transportation agencies and private entities are needed to capitalize on the potential for applying the latest technologies. New forms of "public/private partnerships" offer the potential for:

- Using private entities to operate transportation systems or supply services at lower costs;

- Increasing the affordability of deploying new technology through cost-sharing of investment in new technology development and deployment;

- Generating needed funds by capitalizing on the commercialization of new products; and

- Capitalizing on the market-responsive orientation of for-profit entities.

In addition, joint development and cost-sharing arrangements between public agencies and private entities may offer more direct access to the latest technologies. For example, the U.S. DOT IVHS program places strong emphasis on the importance and potential of public/private partnerships. In doing so, it is important to maintain the proper emphasis on public goals and objectives.

1.2.3 The I-95 Corridor Coalition

The I-95 Northeast Corridor from Maine along the eastern seacoast to Virginia is a major transportation corridor for passengers and freight in the United States. Designated a Priority Corridor within the U.S. DOT IVHS Program, a unique coalition of 33 state, toll, transit and other transportation entities will be testing and evaluating a wide number of IVHS technologies and services – especially projects focusing on the systems management and information needs to improve multimodal, intercity transportation. The Coalition is intended to be a partnership of the major public transportation agencies together with private sector interests which may act as commercial providers of technology, services and facilities either to the agencies themselves or to the agencies' customers.

A wide array of opportunities have been identified for the Corridor – in both the supply of services and the provision of technology. Opportunities exist in all key functions of IVHS; e.g., surveillance and communication, incident management response and traveler-information as well as in roadside services and regulation. Specific partnering opportunities identified by the coalition may include:

- Revenue/cost-sharing in Corridor IVHS communications (fiber optics, commercial radio subcarrier, etc.) through leasing and joint development of state right-of-way and facilities;

- Revenue/cost-sharing and/or service enhancements from private or commercialized provision of services (towing, emergency services);

- Commercial support/sponsorship for roadside information (HAR, VMS);

- Cost defrayal opportunities through expanded commercial applications for toll tags (credit card use);

- Public/private partnerships in the provision of CVO-related administration (information management);

- Commercial markets in the dissemination of traveler/traffic information to in-vehicle/home/office for private customers or the public sector;

- Contract operation of IVHS functions; and

- Sponsored/cost-shared service plaza services.

Both the financial feasibility and the technical success of the Coalition's long-range program will be substantially dependent on developing methods for partnerships in such areas. Some of these methods may include generic approaches to partnering such as franchising, leasing and licensing agreements, cost-sharing, design/build/operate, service contracts, information trades, etc.

In addition to varying financial advantages, these new forms of public/private partnerships which blur the traditional sectoral roles raise a series of legal/administrative issues which need to be explored. They include procurement constraints, revenue and cost-sharing restrictions, inhibitions to commercialization, intellectual property, rate regulation issues, liability, redress and many others.

Only a few transportation agencies (including some Coalition members) have experience with new roles for the private sector. Therefore, broader exposure to this experience and dialogue with private sector entities is required to clarify:

- The need to alter traditional arrangements with private sector entities;

- Potential partnership opportunities in the Corridor and their benefits;

- Hurdles associated with developing new public/private relationships; and

- Remedies, and especially the role of the Coalition in finding those remedies.

The most obvious participants among the New England states are Massachusetts, Rhode Island, and Connecticut. In the case of Vermont, New Hampshire and Maine, the potential opportunities may not appear to be so obvious. However, with the exception of Connecticut, the New England states do not appear to be taking full advantage of the opportunities presented by the Coalition.

There may be significant opportunities for all six states to benefit from more active participation in the corridor activities for several reasons. First, an unprecedented opportunity exists for taking advantage of the synergism that will occur through cooperative actions. Further, there are many economies of scale when more, rather than fewer, entities are involved in such an enterprise. Finally, it is essential that there be full cooperation among all the states in the I-95 Corridor in order to deal with many interstate problems that will no doubt occur. This relates to programs such as advanced traveler information systems, incident management programs, construction-related congestion mitigation programs, vehicle to roadside communication and other common concerns.

1.2.4 Improved High Speed Ground Passenger Service in the Northeast Corridor

This is an issue that has received enormous attention over the past 25 years or more. Some progress is being made in developing improved high speed rail programs from New York to New England, but much more needs to be done. Various proposals to evaluate individual technologies have risen and fallen in popularity over time. However, this is an issue which, if given high enough sustained attention, could result in seeing major intercity transportation improvements for the 21st Century.

1.2.5 The Application of IVHS Technologies to Commercial Vehicle Operations (CVO)

Section 1.1 identified several examples of cooperative CVO programs that are multi-state in nature. Commercial vehicle operations are essential to the economic vitality of a state and a region. Consequently, it would be in the New England states' interest to establish a comprehensive, six-state program aimed at making commercial vehicle operation safer, more efficient, and more compatible with motor vehicle operations in general.

In addition, such a regional program should incorporate more efficient methods of dealing with intermodal connections. This would include connections at seaports, airports and at rail terminals.

1.2.6 Conclusions

The four examples briefly described above are among the most likely opportunities for the six states to collaborate more effectively in achieving common goals. To do so might result in some short-term sacrifices of immediate returns or gains to individual states. However, if the above initiatives can be seen as providing a substantial economic gain to the region, then all will profit through their success.

■ 1.3 Innovative State DOT Planning Initiatives Outside New England

1.3.1 The Issues

There are several state DOTs outside of New England which have completed or recently initiated statewide planning efforts that could provide some useful examples of innovative approaches to be considered in a New England-wide program of cooperation. This section

describes four such efforts. They include recently completed programs in Ohio, Oregon and Iowa and an initiative currently underway in Wisconsin.

There are several common features that characterize each effort:

1. The need to meet the extraordinary federal requirements imposed by the 1991 ISTEA, the 1990 CAAA and the Energy Policy Act of 1992;

2. The desire to use transportation investments as a leverage to promote economic growth and create jobs;

3. The need to develop the necessary justification to provide state funding for transportation operations and improvements;

4. Comprehensive programs for involving as many citizens as possible in the development of policies, programs and recommendations for future development; and

5. The recognition of the importance of private sector involvement in all aspects of transportation program development.

The following provides a brief description of each effort. The references included with each description can be consulted for more details.

1.3.2 Ohio Department of Transportation[1]

The Ohio DOT embarked upon the "Macro Phase" in the development of a 30-year multimodal transportation plan in 1992. That effort was in response to the demand by Ohio citizens to the State Legislature for a transportation system that is responsive to local needs, promotes economic development and which is environmentally sensitive. In addition, the federal requirements imposed by the 1990 Clean Air Act Amendments, the 1991 ISTEA and the Energy Policy Act of 1992 will influence state transportation policies for the next two decades.

The "Macro Phase" of this comprehensive effort sought the answers to three fundamental questions:

1. Where are we?

2. Where do we want to go?

3. How are we going to get there?

1/ "Access Ohio – Ohio Multimodal State Transportation Plan to the year 2020; Macro Phase," Ohio DOT, October 1993.

The program began with a comprehensive information gathering phase involving public input from throughout the state. Two rounds of "outreach" meetings were held at 71 public meetings involving about 4,300 groups and individuals. This provided the information required to create a multimodal plan that is customer-driven – designed to meet the needs of, and to create an effective partnership among state officials, local authorities, citizens and the private sector.

The public meetings and follow-on analyses provided the material needed by Ohio DOT to develop a comprehensive set of policies and strategies that covered:

- Local projects;
- Macro corridors;
- Economic development;
- Social and environmental factors;
- Rural issues;
- Alternative transportation modes (IVHS, Flex-time, telecommuting, congestion management, etc.);
- Modal programs;
- Intermodal programs;
- Safety;
- Guidelines for continuing input from citizens; and
- Funding issues.

This was followed by the development of five "Statewide Access Ohio" goals and dozens of associated policies. Each metropolitan area's needs were also analyzed.

Of particular interest was a study titled "The Economics of Transportation in Ohio." Its purpose was to examine the economic impact of transportation systems, including the contribution that transportation systems make to the Ohio economy.

The Ohio DOT is now engaged in the "Micro Phase" of its statewide plan in order to analyze in more detail its initial projection of economic, demographic, environmental protection, growth management and land use activities to be consistent with transportation forecasts.

1.3.3 The Oregon Department of Transportation[2]

On September 15, 1992, the Oregon Transportation Commission adopted its first multimodal transportation plan. Prior to that action, separate modal plans had been developed, an action that is typical in most parts of the country. The motivation for doing so was based upon a requirement by the state legislature to develop such a plan as the basis for any future funding increases requested by Oregon DOT. In addition, the plan that was adopted in 1992 meets the requirements of ISTEA. It has two elements.

1. **The Policy Element.** This committed the state to meeting both the requirements of the 1990 CAAA, as well as the Oregon State land and planning requirements and goals. The plan is also coordinated with MPO and local comprehensive plans. It calls for a 10 percent reduction in vehicle miles travelled (VMT) in 20 years, and a 20 percent reduction in VMT in 30 years.

2. **The System Element.** A set of four transportation system scenarios were analyzed, including a financial plan for each. They were:

   - Funding decline (no increases in revenues);

   - Continuation of existing program (with revenues increasing to meet inflation only).

   - Continue existing programs, with a flat highway expenditure (no increase for inflation) and inflation increases for transit and alternative modes.

   - The livability scenario, which included the funding ability to meet all the planning benchmarks for all modes.

The "livability scenario" was selected for further analysis. As part of the comprehensive plan, a package of revenue increases was presented to the legislature, but not approved. The same plan will be used as the basis for a future effort.

A number of important lessons were learned from this experience:

- A major effort was made to successfully include all the constituencies (including those with conflicting goals) in the entire process. The mood of the legislature, however, was not in favor of tax increases for any purpose.

- An effort was made to obtain separate funding for transit and alternative modes, but was not successful.

- Oregon's efforts preceded the national ISTEA legislation, putting the state in a good position to meet those requirements.

- A major commitment is required to establish the appropriate modal partnerships.

2/ "Oregon Transportation Plan," Oregon Department of Transportation, September 15, 1992.

- Oregon DOT was required to maintain the state prohibition on using gas taxes for anything other than highways. Consequently, the plan identifies other funding sources for transit and intercity modes.
- The DOT concluded that only congestion pricing would work effectively to meet the target VMT reductions.
- Work is still needed to develop performance goals for relating transportation and land use.

1.3.4 Transportation and Iowa's Economic Future[3]

The purpose of this study was to determine how transportation policy can be fashioned to improve Iowa's long-term economic prospects. It recognized that transportation policies which were appropriate for yesterday's economic circumstances may not work well today, and they may be badly out of step with tomorrow's needs.

The study focused on state multimodal issues, dealing with pricing, resource allocation, investment and other issues that directly affect the performance of public facilities supporting the transportation of people and goods.

Of particular significance was the close interaction throughout the study with the Iowa Business Council, which is committed to strengthening the quality of life and vitality of the economy in Iowa. It is composed of 19 members who represent major shippers, carriers, manufacturers and leading businesses in the state.

Based upon a comprehensive analysis of the state's economy, the development of a framework for establishing the relationship between economic development and transportation, and the analyses of the various modes of transportation, a set of 10 transportation policy recommendations were made. In summary, they were:

1. Promote efficiency in resource allocation to transportation investments;
2. Assess user charges to cover costs;
3. Establish an effective commercial vehicle monitoring program using automatic vehicle identification and weigh-in-motion capabilities;
4. Reduce cross-subsidies of highway systems;
5. Make wider use of two-lane highways rather than four-lane facilities;

3/ "Transportation and Iowa's Economic Future," 1993, by D.J. Forkenbrock, N.S.J. Foster and M.R. Crum, Public Policy Center, University of Iowa.

6. Encourage a prudent waterway facility program;

7. Coordinate investment and pricing among modes;

8. Use thicker pavements on major highways;

9. Conduct further analysis of longer combination vehicles; and

10. Cooperate with private suppliers of transportation in particular, as they related to intermodalism and new technology.

1.3.5 Wisconsin Department of Transportation[4]

Wisconsin is currently at the stage of doing intermodal planning that appears to be where Oregon was about two years ago. The state has traditionally undertaken a substantial amount of separate modal planning – the typical case in most states. But in the summer of 1991, they started to develop strategies for intermodal planning. This was spurred by a number of environmentally-related law suits, the 1990 CAAA and the 1991 ISTEA. State law now directs the DOT to meet the requirements of ISTEA by June 30, 1994 (a full six months earlier than the federal requirements).

A five-part multimodal planning program called Wisconsin TRANSLINKS 21 has been established to guide the effort. The first part includes a Policy Issues Analysis which calls for the analysis of strategic matters such as land use, air quality, economic development, demand management and transit. A series of issue papers are under development.

The second element provides metropolitan planning guidance. It involves the state's 14 MPOs, which are each developing regional plans. The state DOT is working with them in order to achieve statewide consistency. This includes the development of technical assistance documents that will cover the 15 factors that are part of the MPO planning process. The third and fourth elements incorporate a two-part statewide transportation plan – one for intercity freight and one for intercity passengers. The final element of the statewide effort concerns financial planning. It will look at various planning and funding scenarios, and be subjected to an extensive citizen participation process involving nine regional forums.

A set of 11 newsletters has been sent to about 3,000 people, incorporating topics such as public participation plans, transit plans, local use issues and environmental issues. Another dozen or so newsletters will be issued during the first six months of 1994.

A number of public involvement forums and reports have also been completed. Topics include freight transportation, transit planning, rural transportation, economic development, environmental issues, urban strategies and tourism.

4/ TRANSLINKS 21, Wisconsin Department of Transportation, Office of Public Affairs, Fall, 1993.

As the planning process develops, regional forums will be held around the state to review alternative plans and program directions.

1.3.6 Conclusions

This section briefly summarized the four case studies selected to identify innovative state efforts that consider all the issues that are of concern to New England. They include economic growth, environmental protection, limited financial resources, significant new legislative requirements, and the competition for limited state funds. Similar, but separate state efforts are underway in New England by several states, particularly Maine, New Hampshire, and Vermont. However, if goals of the NETI study and "plan for cooperation" are to be implemented successfully, the major initiatives briefly described here, taken collectively as one region in New England, could potentially achieve a level of success that no individual state could achieve on its own.

1.4 Opportunity for Joint Action by the New England States to Address Federal Planning Regulations

1.4.1 The Issues to be Addressed

The ISTEA Planning requirements call for the consideration of 20 factors in the formulation of a statewide plan, and 15 factors in the development of metropolitan plans. It requires that the plans be fully coordinated and compatible; that they provide connection between rail, commercial motor vehicle, waterway and aviation facilities; that they consider land use as an essential element in transportation; and that they facilitate the movement of people and goods. Further, ISTEA also requires that states incorporate all transportation demand requirements, including recreational travel; social implications; economic factors; and the environmental considerations resulting from the 1990 Clean Air Act Amendments (CAAA), the Federal Water Pollution Control Act, and the National Energy Act. ISTEA also requires the development of six management systems, which deal with pavements, bridges, congestion, transit, safety, and intermodal systems. This is a very tall order, since no one has ever done it before. There are very few examples we can turn to which combine all of those requirements and more.

For the most part throughout the nation, states are still working with planning methods and data that were designed for the planning requirements of the 1960s, 1970s, and 1980s. It is doubtful that new methods or approaches can be developed to help the state DOTs and MPOs which must complete the first generation of intermodal plans before January 1, 1995. However, the next and continuing generations of transportation plans and programs must take advantage of more advanced and more accurate planning methods and the data required to do so.

The typical action taken by a state or an MPO in meeting such new challenges is to do it alone. Given the reduction in the availability of permanent public employees, consultants are frequently hired to undertake such efforts. Thus, in the case of the six-state New England region, six different "sets" of efforts would typically be undertaken.

Each of the six New England states is clearly unique. However, there are many common characteristics, problems and requirements that must also be addressed. Consequently, there would be great common value and potentially a significant savings if the six states were to collectively develop guidelines and technical procedures for addressing common issues. The most obvious of those common issues include:

- Providing rural transportation services;
- Developing the six ISTEA management systems;
- Addressing the 20 factors that must be considered in developing statewide plans;
- Addressing the 15 factors in the development of MPO plans;
- Dealing with the requirements of the 1990 CAAA;
- Analyzing alternative funding sources;
- Developing methods to use the private sector to provide services;
- Planning and developing intermodal terminal connections; and
- Developing economic analyses models.

1.4.2 Conclusion

A commitment to the development of applied research programs to address the kinds of issues described above could be a logical recommendation of the NETI process. In addition, a number of joint training programs could be established to develop regional capabilities to address these matters on a continuing basis.

1.5 The Need for Innovative Funding Mechanisms for Transportation

1.5.1 Summary of the Issues

Every state DOT in the nation has always been, and will no doubt always be, constrained in what it feels must be accomplished because of limited financial resources. The passage of the ISTEA authorization brought with it the anticipation of increased federal resources; but to date the yearly appropriations have been substantially less than the authorized amounts. ISTEA also promised to create unprecedented opportunities for flexibility in the use of federal funds for many transportation purposes. However, the definition of how to take advantage of that flexibility has been viewed differently by the various constituencies which are competing for limited federal dollars (i.e., state highway programs, local transit

programs, air quality mitigation programs, etc.) Tables 1.1 through 1.3 provide a summary of the flexibility that is available.

Traditionally, the states have relied upon "user fees" to provide the major source of funding for transportation programs. A major source of those fees has been the gas tax. However, user fees are continuing to be a declining proportion of the funds needed for transportation programs, amounting to less than 50 percent in recent years. Consequently, general revenue sources are being relied upon for an increasing proportion of total funding requirements.

A long-standing issue in the financing of transportation services has been the extent and nature of public subsidies. In particular, the true personal and public costs of automobile travel in comparison to other modes has long been obscured. Public financing through a gas tax collected at the pump where it is indistinguishable from the price of the product is relatively painless and unnoticed by the consumer (except for brief periods when the tax is raised). With the exception of the cost of fuel and parking, the individual cost of auto travel is paid separately via insurance and repair bills and thus not related directly to the cost of individual trips by the consumer. On the other hand, the cost to the consumer of a trip on a common carrier is fully reflective in the ticket price while government subsidies are essentially hidden. Finally, the externalities imposed on society by auto travel in the form of air, water and visual pollution are not reflected in its cost.

A relatively new issue in financing is the increased mandate for more fuel efficient motor vehicles and the increasing use of alternative fuels (which generate no tax revenues – such as electric vehicles, or lower tax revenues produced by gasohol) – further erodes the basis for user fee revenues. We should charge for travel, not the consumption of one fuel or the other. This requires changes in current laws.

The challenge that must be addressed now is to realistically analyze the impacts of the above issues and to develop longer-term strategies for addressing the need for new sources of funds to increase available resources for transportation programs.

1.5.2 Alternative Funding Sources

A National Cooperative Highway Research Program (NCHRP) study currently underway is exploring alternatives for financing surface transportation improvements. That study was initiated by the American Association of State Highway and Transportation Organizations (AASHTO) because current revenue sources for maintaining the nation's transportation system are inadequate to meet present and projected needs. The primary form of highway funding today, motor-fuel taxes, is not effective because it has not kept pace with inflation, and cars are more fuel efficient. In addition, alternatively-fueled vehicles would further diminish the effectiveness of motor fuel taxes in the future.

The purpose of the NCHRP project is to examine alternative methods to the traditional motor-fuel tax that can be used as a principal way to finance the surface transportation system. The following alternatives are being considered and evaluated:

- Current fuel taxes;
- Taxes on alternative fuels;
- Registration fees (or vehicle use taxes);
- Vehicle miles of travel fees;
- Vehicle and vehicle parts sales taxes;
- Pavement damage fees or weight-distance taxes;
- Congestion pricing;
- Emissions fees;
- Person miles of travel fees;
- Takeoff and landing fees;
- Docking fees;
- Parking fees; and
- Equity adjustment fees.

Certain criteria were considered when examining these alternative financing sources as potential methods to finance the transportation system. The adequacy and efficiency of collecting funds were examined, as was funding equity among system users. In addition, the costs of administering and enforcing the different programs were considered, along with the potential risk of evasion.

The advantages of the current fuel taxation include a low compliance cost and low administrative costs. The report also finds that some alternative fuels can be taxed in the same way. It concludes that fuel taxation will remain a viable option in the future, but should be augmented by other transportation funding sources.

Taxes based on vehicle miles traveled were found to be the most equitable source of funding. In addition, this source has the most potential for offering major improvements in finance. Taxing vehicle miles also distributes costs by vehicle use and thus taxes most heavily those who most contribute to the externalities of auto usage such as air pollution and congestion.

However, implementing such a taxation system would be difficult, and the current technology to measure vehicle miles traveled is also in question. The optimal technological systems for measuring vehicle miles traveled needs further investigation. However, IVHS technologies offer new opportunities to do so.

1.6 The Potential for Leveraging New England's Congressional Influence

1.6.1 The Issues

The six New England states have historically been represented by an outstanding group of U.S. Senators and Representatives in the U.S. Congress, who have yielded significant influence in many areas. In recent years that Congressional influence has been instrumental in obtaining substantial federal funding for large public works projects which will have positive regional impacts. For example, those projects include $30 million for Amtrak service to be introduced from Portland to Boston; about 87 percent federal funding for the $7.7 billion Central Artery/Tunnel project; and over $100 million for the water and sewer improvements to cleanup Boston Harbor. There have been many other projects directed to individual states as well.

The following Table 1.4 summarizes the number of senators and representatives in selected individual states. Note, for example, that Florida has the exact number of 23 representatives as does all New England; Illinois and Pennsylvania have slightly fewer; and Texas and New York have slightly more. But, the New England states are represented by 12 U.S. Senators, whereas all of the others have only two Senators each.

To further explore the situation, we analyzed the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) to determine the number and amounts of earmarked funds in the ISTEA authorization. This included specific "demonstration projects" (not all of which will necessarily be funded); new transit starts; bus earmarks; and earmarked IVHS demonstrations or operational testing programs. Table 1.5 summarizes this information for each individual state in New England; New England as a whole; and for selected states.

Note in Table 1.5, that if one very large project in Maine is eliminated (a $134 million bridge in Portland), the total New England earmarks are on the order of $153 million. Table 1.5 lists 14 individual states where earmarks of $150 million or more were authorized. If one examines the data for those states that have roughly the same number of U.S. representatives as the combined number for New England, the following is noted:

All of New England	$	153,100,000	(without bridge)
Florida		179,560,000	
Illinois		424,430,000	
New York		1,049,230,000	
Pennsylvania		952,614,000	
Texas		271,400,000	

If we eliminate the Portland bridge, each of those individual states have substantially greater earmarks than all of New England.

This analysis by itself is not necessarily conclusive in all respects. However, it does illustrate one measure of the value of one group of congressional forces combining their resources and influence to substantially affect the direction of federal funds to a state or region.

Tables

Table 1.1 ISTEA Funding for Highways

Basic Categories	Basis for Funding	Purpose
1. Interstate Construction (IC)	Need – Cost to Complete	a. Exclusively for IC b. Interstate Transfer
2. Interstate Maintenance (IM)	Formula	Interstate Maintenance
3. National Highway System (NHS)	Formula	155,000 Mile System Includes Interstate, Urban and Rural Principal Arteries, Connections to Intermodal
4. Bridge Replacement and Rehabilitation (BR)	Need	Bridges
5. Congestion Mitigation and Air Quality (CMAQ)	Formula	States and Metro areas classified as non-attainment areas for Ozone and CO
6. Surface Transportation Program (STP)	After formula for <u>all</u> funds, what is left over A BLOCK GRANT	For any of the above, transit, and enhancements

Table 1.2 ISTEA Funding for Transit

Basic Categories	Basis for Funding	Purpose	
1. Formula Grants	Formula	Section 9: (Urban)	Capital and Operating Highway TMAs
		Section 18: (Rural)	Same
2. Discretionary	FTA and Transit Agencies	New Starts: 40% of total Rail Modernization: 40% total Bus and Other: 20% of total	

Table 1.3 ISTEA Flexibility

Highway Category	Flexibility Features
IC	Dedicated exclusively to complete construction of the interstate system
IM	20% can be transferred to NHS or STP without Secretarial approval
NHS	50% can be transferred to STP w/o Secretarial approval; Up to 100% transferred with Secretarial approval
BR	40% can be transferred to NHS or STP without Secretarial approval
CMAQ	No transfer provisions, but funds can be used for transit capital improvements
	But, if a state has no non-attainment areas, then 100% can go to STP
STP	Funds can be used for any highway or transit purpose, and for enhancements

Table 1.4 New England's Congressional Strength Relative to Other States

Region/State	Number of U.S. Senators	Number of U.S. Representatives
New England	12	23
New York	2	31
Virginia	2	11
Florida	2	23
Illinois	2	20
New York	2	30
Pennsylvania	2	21
Texas	2	30

Table 1.5 ISTEA Earmarks

	ISTEA	New Transit Starts	Bus Earmarks	Total
Connecticut	$ 79,400,000	$ 0	$ 0	79,400,000
Maine	187,100,000*	25,500,000	0	212,600,000
Massachusetts	5,900,000	38,250,000	0	44,150,000
New Hampshire	32,100,000	0	0	32,100,000
Rhode Island	57,410,000	0	0	57,410,000
Vermont	20,000,000	0	0	20,000,000
New England Total with Bridge	**$ 381,910,000**	**$ 63,750,000**	**$ 0**	445,660,000
New England Total without Bridge	**$ 153,100,000**			153,100,000
All States Total	**$7,112,844,000**	**$721,805,000**	**$336,940,000**	8,171,589,000

* This includes one project worth $134,000,000 (Bridge in Portland).

Table 1.5 ISTEA Earmarks (continued)

Selected State Data

with approximately equal number of U.S. Representatives
with $150,000,000 or more in ISTEA earmarks

States	ISTEA Earmarks	Number of U.S. Representatives	States	ISTEA Earmarks	Number of U.S. Representatives
Alabama	$152,550,000	7	New Jersey	202,900,000	13
Arkansas	297,200,000	4	New Mexico	10,800,000	3
California	344,800,000	52	New York	1,049,230,000	31
Florida	179,560,000	23	Ohio	165,000,000	19
Illinois	424,430,000	20	Pennsylvania	952,614,000	21
Maryland	185,100,000	8	Texas	271,400,000	30
Minnesota	236,273,333	8	Virginia	172,533,333	11
Mississippi	24,600,000	5	W. Virginia	365,200,000	9
Missouri	152,733,333	9			

2.0 Highways

2.0 Highways

In the Draft Inventory Report for this project, an existing conditions capacity analysis was presented for roadways that have been proposed for inclusion in the National Highway System (NHS). Data problems prevented the inclusion of Connecticut and Maine data in the inventory report. The results of the capacity analysis for existing conditions on Connecticut and Maine NHS roadways are summarized below prior to discussing the results of the forecasting and trends assessment task for all New England NHS roadways. Figure 2.1 shows the complete NHS for New England. Figure 2.2 through 2.5 shows the existing daily volume-to-capacity ratios for all states. A description of existing conditions in the other four states is provided in the Inventory Report.

Volume to capacity ratios were developed based on existing conditions data supplied by the states, then projected into the future using the assumptions described. The data are based on average annual daily volume and peak hour factors using industry standard methodologies. A 90 percent peak hour V/C ratio on an annualized basis was used to define a congested facility. As with all of the NETI analyses, the goal is to present a regional picture at a generalized level. It should be understood that the facilities identified as "congested" are not always congested, and that other facilities are congested some of the time. For example, roadways in popular recreational areas may be highly congested for several months of the year, and experience very low volumes the rest of the time. On an annualized basis, such facilities are not congested. Several such facilities are identified in the text. This methodology should not lead one to assume that other facilities may not warrant appropriate public policy attention.

2.1 Existing Conditions

2.1.1 Connecticut

The methodology for conducting the capacity analysis of NHS roadways was presented in the Draft Inventory Report. The Connecticut Department of Transportation submitted 1992 annual average daily traffic (AADT) and other data for NHS roadway segments in the state. Peak hour volume-to-capacity (v/c) ratios were calculated for each NHS roadway segment, and the results are displayed in Figure 2.2. Generally, highway segments with v/c ratios in excess of 0.90 are operating at or near capacity during peak hours. These "congested" highway segments in Connecticut are discussed below.

Significant portions of Interstate Routes 84, 91, and 95 in Connecticut operate at or near capacity (v/c greater than 0.90) during peak hours. These congested highways generally

follow the state's "urban spine," beginning at the southwestern corner of the state and running to New Haven, then running north to Hartford. Beginning at the New York state line, Interstate 95 has six lanes and an AADT of 116,000 vehicles. Prior to its junction with Interstate 91 in New Haven, I-95 exhibits similar traffic volumes (111,900 AADT on a six-lane section). East of New Haven, I-95 narrows to four lanes and AADT ranges between 49,000 and 58,000 with v/c ratios in excess of 0.90 on short segments in urban areas. The relatively long highway segments (links) used in this analysis tend to overstate the extent of congestion shown on Figure 2.2, especially on I-95 east of New Haven.

Most of I-91 in Connecticut is six lanes wide and operates at or near capacity during peak hours except for the section of I-91 north of Hartford where HOV lanes are present. Beginning in the south in New Haven, I-91 has an AADT of 74,300. In the Hartford area, AADT rises to 99,500. Just south of the Massachusetts line, AADT decreases to 71,900.

West of Hartford, I-84 operates at or near capacity (v/c greater than 0.90) during peak hours. In the western part of the state near Danbury, I-84 has an AADT of 92,000 vehicles on a six-lane section. In the vicinity of Waterbury, I-84 narrows to four lanes with an AADT of 54,500 west of the city and 76,900 east of the city toward Hartford. Just west of I-91 in Hartford, I-84 is eight lanes wide with an AADT of 113,100 vehicles. East of Hartford, I-84 drops to six conventional lanes with an AADT of 66,400. HOV lanes from Hartford east to Vernon help to dampen congestion on this portion of I-84.

Another major highway that operates at or near capacity is CT 15, the Merritt Parkway. AADT on this four-lane parkway ranges between 43,000 and 55,600 with the highest volumes in the Bridgeport area. The analysis of 1992 AADT data shows v/c ratios in excess of 0.90 on the Merritt Parkway from New York to the intersection with CT 10 near North Haven.

Other NHS road segments in Connecticut that exhibit peak hour congestion with v/c ratios in excess of 0.90 are:

- **U.S. 7**, an 18-mile long, two-lane highway section between the Merritt Parkway and I-84, which has an AADT of 21,800;
- **CT 8**, a seven-mile long, four-lane highway section between the Merritt Parkway and SR 34, which has an AADT of 40,300;
- **I-691**, a six-mile long, four-lane highway section between CT 10 and I-91 in Meridan, which has an AADT of 40,700;
- **CT 72**, a two-mile long, four-lane highway section between I-84 and CT 10 in the New Britain area; and
- **CT 2**, two-lane highway segments: one just south of I-95 near Pawtucket (AADT 18,000) and the other just east of I-395 in Norwich (AADT 24,200).

2.1.2 Maine

Volume-to-capacity (v/c) ratios were calculated for all NHS roadways in Maine based on data supplied by the Maine Department of Transportation (MDOT). The results are shown in Figure 2.3. MDOT was unable to supply data for several of the factors used to determine peak hour volumes and capacities. Based in part on characteristics of I-95 in New Hampshire, the following values were applied to all NHS links in Maine:

K-factor	12%	(Percentage of daily traffic that occurs in peak hour)
Directional Split	60%	
Percent heavy trucks	1%	
Peak hour factor	90%	(Hourly volume divided by peak 15-minute flow rate)

Because roadway-specific rates were not available for Maine, the resulting analysis for Maine roadways is less accurate than that included for the other states.

The capacity analysis based on 1992 AADT data revealed one NHS roadway segment in Maine with a v/c ratio greater than 0.90: ME 196 between U.S. 1 and I-95. This two-lane road in the Brunswick area has an AADT of 24,600.

2.2 Future Conditions

2.2.1 General Approach

The year 2000 was selected as the general forecast date for all transportation modes including highways. A high volume and a low volume forecast were developed. The high volume forecast was developed based on annual percentage growth rates used by each state in projecting vehicle miles of travel (VMT) growth between 1990 and 1996. These figures were recently provided by each state to the U.S. Environmental Protection Agency (EPA) in their State Implementation Plan (SIP). The 1990 and 1996 VMT estimates and the corresponding annual growth rates are summarized in Table 2.1. These annual growth rates, which range from 1.2 to 2.5 percent, were applied to the AADT data for each state to calculate a high volume AADT for 2000 and corresponding v/c ratios for all NHS links in New England.

A low volume forecast was developed for 2000 using annual percentage growth rates corresponding to the projected annual increase in New England population of 0.4 percent presented in Chapter 7.0 of this report.

The low volume forecasts are shown in Figure 2.6 through 2.9; the high volume forecasts are shown in Figure 2.10 through 2.13.

2.2.2 Connecticut

Low Volume Forecast 2000

Existing AADT data supplied by the Connecticut DOT were grown by 0.4 percent per year to produce low volume AADT estimates for the year 2000. A capacity analysis was performed on this data set, and three additional NHS roadway segments in Connecticut exhibited v/c ratios greater than 0.90:

- **CT 8**, a four-lane highway segment between CT 34 in Shelton and I-84 in Waterbury. This segment is 17 miles long, and AADT is projected to increase to 39,440 in 2000. The adjacent segment of CT 8 south of CT 34 is currently at or near capacity during peak hours.

- **CT 9**, a four-lane highway segment running west from U.S. 5 to New Britain. AADT on this four-mile long segment is projected to increase to 46,667 in 2000.

- **CT 2**, a four-lane highway segment approaching Hartford from the southeast. AADT on this three-mile long segment between CT 3 and I-84 is projected to increase to 42,537 in 2000.

High Volume Forecast 2000

Existing AADT data were grown by 1.47 percent per year to produce high volume AADT estimates for the year 2000. A capacity analysis of this data set was performed, and two additional NHS roadway segments in Connecticut exhibited v/c ratios in excess of 0.90:

- **CT 202**, a two-lane highway segment between U.S. 44 and the Massachusetts state line northwest of Hartford. AADT on this 14-mile long segment is projected to increase to 30,296 in 2000.

- **U.S. 5**, a four-lane highway segment approaching Hartford from the south. AADT on this nine-mile long segment between CT 9 and I-91 is projected to increase to 54,420 in 2000.

Planned Capacity Enhancements

The State of Connecticut is currently involved in either the planning or actual construction of several projects aimed at increasing the capacity of interstate highways. Two of the more significant projects on I-95 are an add-a-lane project on southbound I-95 in Darien and Stamford and the installation of an incident management system along I-95 in Greenwich, Stamford, and Darien. High-occupancy vehicle (HOV) lanes on I-84 are being extended between Hartford and East Hartford.

Over $200 million is programmed for the reconstruction, widening and upgrade of the section of U.S. 7 between Norwalk and Danbury as well as the construction of a new expressway between Norwalk and Wilton. The State also plans to reconstruct CT 2 in Norwich. Over $42 million is programmed for an upgrade and related environmental

studies for CT 15, the Merritt Parkway. About $300 million is programmed for the eastward extension of I-384 in Bolton, Coventry, and Andover.

2.2.3 Rhode Island

Low Volume Forecast 2000

An annual growth rate of 0.4 percent was applied to existing AADT data for Rhode Island to produce low volume AADT estimates for the year 2000. A capacity analysis was performed on this data set, and three additional NHS roadway segments in Rhode Island exhibited v/c ratios in excess of 0.90:

- **RI 1A**, a one-half-mile long, two-lane, undivided road east of I-95 in Providence. Under the low growth scenario, AADT on this segment is projected to increase to 18,202.

- **RI 136**, a two-mile long, two-lane, undivided road segment between RI 103 and the Massachusetts state line. Under the low growth scenario, AADT on this segment is projected to increase to 19,100.

- **Airport Connector**, a one-mile long, four-lane divided local road linking I-95 and the T.F. Green Airport in Warwick. Under the low growth scenario, AADT on this roadway is projected to increase to 43,466.

High Volume Forecast 2000

An annual growth rate of 1.2 percent was applied to existing AADT data for NHS roadways in Rhode Island to project AADT for the year 2000 under the high growth rate scenario. A capacity analysis was performed for this data set, and no additional highway segments exhibited v/c ratios greater than 0.90.

Planned Capacity Enhancements

The State of Rhode Island has included in its short-range plan the relocation of I-195 to improve address capacity and safety deficiencies. The State has programmed the upgrade of U.S. 6 from the Connecticut state line to the junction with I-295 in Johnston. The construction of a new limited access road, Quonset Access Road, in East Greenwich is also programmed. This new highway will connect to SR 4 and I-95 and serve the Quonset Point/Davisville area. The state has also programmed, and amended its system plans to accommodate the T.F. Green Airport project, including the connector road.

2.2.4 New Hampshire

Low Volume Forecast 2000

An annual growth rate of 0.4 percent was applied to existing AADT data for NHS roadways in New Hampshire to project AADT for the year 2000 under the low growth rate

scenario. A capacity analysis was performed on this data set, and no additional NHS segments exhibited v/c ratios in excess of 0.90.

High Volume Forecast 2000

A projection of AADT in the year 2000 under a high growth alternative was made by applying an annual growth rate of 2.5 percent to existing AADT data. The resulting capacity analysis showed two new NHS highway segments in New Hampshire at or near capacity during peak hours (v/c greater than 0.90):

- **NH 51**, a two-lane undivided highway segment in Stratham, Exeter, and Hampton. AADT is projected to increase to 18,790 by the year 2000. This four-mile long highway segment is part of the two-lane section of NH 101/51 linking I-93 in Manchester to I-95 in the Seacoast. The other two-lane segment to the west (NH **101**) does not show a v/c greater than 0.90 primarily because of a lower K factor. Nonetheless, this eight-mile segment has a high accident rate and capacity constraints according to the NHDOT.

- **U.S. 3**, a two-lane undivided highway in Laconia and Merideth. AADT on this eight-mile long segment is projected to increase to 15,361 by the year 2000.

Planned Capacity Enhancements

The State of New Hampshire is addressing congestion on the F.E. Everett Turnpike (U.S. 3) in two ways. First, the State plans to construct a new limited access, circumferential highway east of the turnpike through Hudson. In addition the State plans to widen the central portion of the F.E. Everett Turnpike. Minor reconstruction work is planned for U.S. 3 in Merideth and NH 16 in Conway, two highways heavily affected by recreational traffic.

The State's highest priority transportation improvement project is the widening of the current two-lane, undivided section of NH 101 and NH 51 east of NH 125. The widening will occur in the towns of Epping, Brentwood, Exeter, Stratham, and Hampton.

2.2.5 Maine

Low Volume Forecast 2000

An annual growth rate of 0.4 percent was applied to existing AADT data for NHS roadways in Maine to project AADT in the year 2000 under the low growth rate scenario. The resulting capacity analysis showed one additional NHS road segment reaching capacity or near-capacity conditions:

- **I-295**, the northern section between U.S. 302 in Portland and the junction with I-95 in Falmouth. This six-mile long, four-lane divided highway is projected to have an AADT of 45,221 in the year 2000 under the low growth rate scenario.

High Volume Forecast 2000

Applying an annual growth rate of 2.35 percent to existing AADT data for Maine NHS roadways shows two additional links with v/c ratios greater than 0.90 in the year 2000:

- **I-295**, the southern section between U.S. 302 in Portland and the junction with I-95 in Scarborough. AADT on this six-mile long, four-lane divided highway would increase to 50,938 in the year 2000 under the high growth scenario.

- **I-95 (Maine Turnpike)**, the eight-mile long, four-lane divided highway between I-295 in Scarborough and I-195 in Saco. AADT on this segment would increase to 46,964 under the high growth forecast.

Planned Capacity Enhancements

Only minor improvement projects on NHS roadways in Maine are contained in the Maine DOT's Multimodal Transportation Improvement Program for Fiscal Years 1994-1995. In Transportation to the Year 2002: A Capital Improvement Plan for Maine, the Maine Transportation Improvement Planning Commission determined that improvements to provide additional capacity on NHS roadways in Maine to address congestion and safety deficiencies would require expenditures of approximately $14 million per year. In this plan, the commission did not identify specific roadway segments where capacity enhancing projects should be constructed. Earlier plans by the State to widen portions of the Maine Turnpike were set back by the voters at the same time that the voters passed the Sensible Transportation Policy Act. The status of previous plans to widen I-295 in the Portland area from four to six lanes is unclear. The Maine DOT is now developing plans to implement extensive transportation demand management (TDM) projects on U.S. 1 in the mid-coast area, an NHS roadway heavily influenced by summer recreational travel.

2.2.6 Vermont

Low and High Volume Forecasts 2000

Existing AADT for NHS roadways in Vermont were grown by 0.4 percent per year to produce a low growth forecast for the year 2000. An annual growth rate of 2.28 percent was used to produce the high growth rate forecast for the year 2000. Volume-to-capacity (v/c) ratios were computed for both forecasts, and no NHS roadways exhibited v/c ratios in excess of 0.90.

Planned Capacity Enhancements

The State of Vermont has plans for enhancing capacity on many of its NHS roadways primarily through reconstruction and relocation projects. Some of the more significant projects are the relocation of U.S. 2 around East Montpelier, the reconstruction of U.S. 2 in Marshfield, and the relocation of U.S. 7 around Bennington. Over $30 million in reconstruction and relocation projects are planned for VT 9 in Marlboro, Brattleboro, Searsburg, and Wilmington.

A significant new highway project is the Chittenden County Circumferential Highway (VT 289) which will function as a bypass of Burlington east of the city. A four-mile section in Essex is now open. The project is designed as a four-lane divided, limited access facility, but it is currently a two-lane facility on a four-lane right-of-way. The remainder of the project is in design and rights-of-way have been procured except for the Colchester section. Sufficient funds to complete the project have not been identified.

2.2.7 Massachusetts

Low Volume Forecast 2000

An annual growth rate of 0.4 percent was applied to existing AADT data for NHS roadways in Massachusetts to project AADT for the year 2000 under the high growth rate scenario. A capacity analysis of this data set showed two additional NHS road segments exhibiting v/c ratios in excess of 0.90:

- **I-495**, in Lawrence north of MA 114. AADT on this four-lane section is projected to increase to 69,831.
- **MA 114**, in North Andover south of I-495. AADT on this two-lane road is projected to increase to 31,097.

High Volume Forecast 2000

High-growth projections of year 2000 AADT on Massachusetts' NHS roads were made using an annual growth rate of 2.44 percent. A capacity analysis based on these projections revealed a significant increase in NHS roadways in Massachusetts that would be operating at or near capacity conditions during peak hours. These roadway segments are grouped by geographic area and described below.

North of Boston

- **U.S. 3**, the two northernmost sections of this four-lane facility in Massachusetts north of MA 40 where AADT would increase to about 65,000 vehicles. (The remainder of U.S. 3 to the south showed v/c ratios greater than 0.90 in the existing conditions analysis.)
- **I-93**, a six-mile long, six-lane wide section beginning in Andover at the MA 133 junction (south of I-495) to the junction with MA 213 in the Lawrence area (north of I-495)2. AADT is projected to increase about 115,000 vehicles.
- **I-93**, a three-mile long, eight-lane wide section immediately north of I-95/MA 128 where AADT is projected to increase to about 155,000 vehicles. (With the addition of these two segments to the "congested" category, all of I-93 in Massachusetts is projected to operate at or near capacity during peak hours with the exception of short segments in Andover and Wilmington.)
- **MA 114**, a two-lane segment in Peabody just east of MA 128 with a projected AADT of 37,269.

- **MA 107**, a two-lane segment south of MA 114 in Salem with a projected AADT of 33,977.

- **MA 60**, a two-lane segment in Malden between U.S. 1 and I-93 with a projected AADT of 33,542.

- **MA 16**, a four-lane segment in Revere with a projected AADT of 79,507.

South of Boston

- **U.S. 44**, a two-lane segment in Taunton with a projected AADT of 79507.

- **MA 3**, a four-lane segment in Norwell with a projected AADT of 80,749.

- **MA 139**, a two-lane segment in Hanover with a projected AADT of 33,542.

- **MA 3A**, a two-lane segment in Quincy with a projected AADT of 33,542.

- **MA 53**, a two-lane segment in Quincy with a projected AADT of 33,542.

- **MA 37**, a two-lane segment in Braintree with a projected AADT of 37,269.

- **MA 24**, a six-lane segment between SR 27 in Brockton and I-93/SR 128 in Randolph with a projected AADT of about 117,000.

- **MA 138**, a two-lane segment in Canton south of I-93/SR 128 with a projected AADT of 31,057.

- **MA 28**, a four-lane segment in Milton north of I-93/SR 128 with a projected AADT of 62,115.

West of Boston

- **U.S. 3/MA 2 (Alewife Brook Parkway)**, a two-lane segment in Cambridge and Somerville with a projected AADT of 33,542.

- **MA 16 (Mount Auburn Street)**, a two-lane segment in Watertown with a projected AADT of 33,542.

- **U.S. 3 (Memorial Drive)**, a two-lane segment in Cambridge with a projected AADT of 33,542.

- **U.S. 20 (Boston Post Road)**, a five-mile long, two-lane segment in Weston west of I-95/SR 128 with a projected AADT of 33,294.

- **I-90 (Masspike)**, the six-mile long, six-lane section immediately west of I-95/SR 128 in Weston and Wayland with a projected AADT of 111,624 vehicles.

- **I-90 (Masspike)**, the four-mile long, six-lane section immediately east of I-95/SR 128 in Newton with a projected AADT of 104,819 to 120,835 vehicles.

- **MA 9 (Worcester Street)**, a six-mile long, four-lane segment in Wellesley west of I-95/SR 128 with a projected AADT of 67,208.

- **MA 9 (Huntington Avenue)**, a two-lane segment in Boston with a projected AADT of 33,542.

Springfield Area

- **I-291**, a one-half-mile long, four-lane section immediately east of I-91 with a projected AADT of 97,656.

- **I-91**, a one-mile long, five-lane section immediately south of I-291 with a projected AADT of 96,927.

- **I-91**, a one-mile long, four-lane segment in Holyoke with a projected AADT of 82,256 to 86,727 vehicles.

- **U.S. 202/MA 10**, a two-lane segment in Westfield with a projected AADT of 33,715.

Planned Capacity Enhancements

The Central Artery/Tunnel (CA/T) project will add capacity to the north-south section of I-93 through Boston and extend I-90 to Logan Airport via a third harbor tunnel. Currently under review is a plan to add an HOV lane to the Southeast Expressway between Boston and Braintree. The shoulder lane in the flow direction is now used as a travel lane during peak hours. HOV efforts are also being planned for I-93 north of Boston where an existing carpool lane would be extended. Massachusetts is also considering adding a standard travel lane or HOV lane on MA 3 between Hingham and Plymouth.

An add-a-lane project (possibly HOV) is also being considered for the existing six-lane section of I-95/MA 128 between I-95 in Canton and MA 9 in Wellesley. Both shoulder lanes are now used as travel lanes during the morning and afternoon peak periods on this section of I-95/MA 128. The Executive Office of Transportation and Construction (EOTC) is currently evaluating Intelligent Vehicle Highway System (IVHS) applications in the I-95/SR 128 corridor and in the I-93 corridor north of Boston.

A major upgrade of U.S. 3 between I-95/MA 128 and the New Hampshire border is in the planning stage. Plans are currently being developed to expand the highway from four to six lanes. Other upgrade projects in the planning stage include U.S. 44 between Plymouth and Taunton, MA 2 between Fitchburg and Greenfield, and MA 146 between Worcester and the Masspike.

2.3 Motor Carriers

In the Inventory Report of the NETI Study, only a brief discussion of motor carriers was included. Subsequent comments received during the Inventory review period indicated that, given the vital role of motor carriers to the New England economy and their dependence on transportation systems, trucking should be addressed in more detail within the NETI project. A review of existing New England trucking activity is presented in Sections 2.3.1 through 2.3.3. Section 2.3.4 identifies regional trucking issues and their implications to the industry.

2.3.1 Key Issues/Focus

Many people view the trucking industry as monolithic, assuming that all trucks are 18-wheelers operating cross-country as part of large fleets. In reality, the motor carrier industry in New England, as in the rest of the country, includes many types of operations, equipment, and fleet sizes. The industry is highly fragmented, reflecting the complexity and diversity of the many businesses, industries, government agencies, and consumers they serve.

Two important features of the New England trucking industry should be noted. First, trucking is important to every segment of the economy, from construction to manufacturing to agriculture; even many service industries rely exclusively on trucks for goods and supplies deliveries. In addition, there is no "dominant" player in the New England motor carrier industry; both regionally-based carriers and carriers based outside of New England play an important role in moving freight into and out of the six New England states.

Issues that are critical to distinguishing and defining the motor carrier industry in New England include the following.

A Significant Imbalance Between Inbound and Outbound Freight Movements

Because of New England's location at one end of the national transportation infrastructure, and the relative lack of manufacturing in the region, a far greater amount of goods enters New England than is moved out of the region; overall, about twice as much freight comes inbound to New England than moves out of the region. Due to the disparity between inbound and outbound freight, the major motor carriers bringing freight into New England have an incentive to discount their services heavily in the outbound direction. New England-based carriers tend to be smaller than their national counterparts and cannot compete with the discounting; this is contributing to the shrinking number of New England-based carriers. The thriving New England carriers tend to be focused on a particular niche of the market, such as moving air freight to Logan Airport or transporting specialized equipment.

Lack of Regulatory Uniformity

Although many businesses and trucking companies operate in multiple states, motor carriers remain subject to regulation and taxation by each individual state through which they pass. Because each state has its own unique needs, administrative structure, and regulations, the motor carrier regulatory system has become staggeringly complex. This complexity imposes a considerable burden on both the motor carriers, who must comply with the regulations, and the state agencies, who must administer them.

The lack of regulatory uniformity within the region is perceived by some in the industry to be greater than it is in other regions. Efforts to standardize fines and other enforcement strategies on a regional basis have not been fruitful, outside of the establishment of the New England Transportation Consortium, a regional group involving Maine, New Hampshire, Vermont, Massachusetts, and Connecticut, which issues permits for operating oversize or overweight vehicles on designated routes in the member states.

The lack of regulatory uniformity across states imposes a burden on carriers to identify the unique business requirements of each state in which they do business. Failure to be aware of each state's regulations may result in fines and citations. For example, Maine has a unique procedure for obtaining a 53-foot trailer permit. Maine is the only state that charges a fee for this permit; in other states, the permit is required but is provided at no charge. In addition, in Maine these permits are issued on an individual truck basis, whereas they are issued by fleet in other states. Carriers entering Maine from other states without the proper permit will be cited; if they enter after business hours, they may find the permit particularly difficult to obtain and may not even realize that it must be purchased because this requirement is not common in the course of doing business with every other state.

The lack of regulatory uniformity also complicates the burden of ensuring that all the required credentials have been obtained. Failure to obtain a credential may be due not to willful evasion but to a lack of organized, available information about what compliance requires in each state. This is less of an issue with national programs such as the International Registration Plan (IRP) and the International Fuel Tax Agreement (IFTA) than it is with local requirements such as size/weight restrictions and local taxes. For example, Vermont is the only state where a carrier moving an oversize or overweight load off of the designated route must obtain approval from each affected town before the Agency of Transportation will provide a permit for the movement – no other New England state has a similar requirement for procuring local approvals.

Infrastructure considerations are the underlying cause of some of the lack of regulatory uniformity between the New England region and other parts of the country. For example, allowable vehicle sizes and weights in New England are smaller and lighter than in the rest of the country; in part, this is because many of the older New England roads were not designed to carry heavy trucks as were newer highways in other states.

As another example of the lack of regulatory and enforcement unity, Maine has a much higher than average rate of out-of-service violations among the carriers on which its officers perform weight, safety, and credential inspections. "Out-of-service" (OOS) violations represent vehicle or driver safety infractions considered to pose an immediate

danger to the public. The national average for OOS violations is about 28 percent for all vehicles inspected and seven percent for drivers; in Maine, the overall rate is 50 percent. This reflects the use of a selective enforcement strategy in Maine based on probable cause, instead of a more random selection as is common in other states.

A Unique Fuel Tax Agreement

A significant issue for many New England-based carriers is that if they operate in states outside of New England, they are required to participate in two fuel tax agreements – the International Fuel Tax Agreement (IFTA) and the Regional Fuel Tax Agreement (RFTA). Both of these agreements were formed about 10 years ago to encourage uniform administration of the motor carrier fuel taxation laws and to establish a base state agreement for collecting and administering fuel use taxes. Licensing with the base state satisfies a carrier's fuel tax licensing obligation to all members, and the base state distributes payments and collects refunds for all carriers. The RFTA includes only its original three member states of Maine, New Hampshire, and Vermont, while membership in the IFTA has grown substantially. Consequently, carriers doing business in states other than the RFTA states must also join the IFTA; this duplication of effort imposes an administrative burden on these carriers by doubling their reporting requirements (i.e., each agreement requires that quarterly reports be filed).

In addition, the ISTEA requires that any state collecting a fuel use tax after September 30, 1996 must belong to the IFTA or a base state agreement that is "not in conflict" with the IFTA. The language is generally interpreted to mean that states belonging to the RFTA need not join the IFTA, but pressure to merge the two agreements is likely, at least with respect to data and funds transfer.

Perception of an Unfavorable Business Climate for the Motor Carrier Industry

In the New England region, it is perceived that there is no coherent strategy for promoting trucking as a business. It is noted that in Massachusetts, there is an effort to promote the rail industry, despite the fact that in Massachusetts, as in the rest of New England, trucking employs many times more people and has a broader economic impact than rail. The trucking industry perceives itself to be at a competitive disadvantage with respect to the railroads because it is taxed more heavily. For example, the railroad industry is not subject to the fuel taxes that are imposed on motor carriers.

The relatively high fees and taxes imposed on motor carriers in New England is perceived as creating an "anti-business climate." Disproportionately high state taxes and operating costs, coupled with stiff competition, have driven many truckers off the road throughout New England. The state and local tax bill for Massachusetts trucks is one of the highest of the nation's industrial states. The Massachusetts Turnpike is the principal east-west route through southern New England, providing access from New York and points west, across Massachusetts to the City of Boston, the Port of Boston, and Logan International Airport. In March, 1990, the tolls paid by trucks for travel along the Turnpike rose by over 50 percent (compared to a 30 percent increase in the tolls for passenger cars and no increase in the bus tolls). Massachusetts levies additional high fees and taxes on its carriers. For example, the state charges property and sales taxes on new vehicles and parts; many states exempt their locally domiciled vehicles from these charges. The amount of total fees and

taxes paid on a five-axle tractor semitrailer in Massachusetts is 34 percent higher than the average amount charged by the 11 largest industrial states.

In Connecticut, the concerns focus on the high property and workers' compensation taxes; in Maine, it is the excise tax that is perceived to be putting Maine-based carriers at a competitive disadvantage. In Rhode Island, high fuel taxes are the focus of the concern. However, Rhode Island carriers are exempt from excise and sales taxes if they operate interstate. This is a concession to the fact that because Rhode Island is so small, carriers with even a small geographic scope of operations must become interstate carriers, and therefore must bear the added cost and regulatory burdens associated with interstate status.

The combination of an environment perceived as not conducive to promoting the trucking business plus the competitive pressures created by deregulation is driving carriers out of New England and out of business. With the St. Johnsbury Trucking Company ceasing operation in 1993, there are no New England-based Class 1 carriers (with annual operating revenues of more than $50 million). Since 1990, an estimated 90 carriers have gone bankrupt in Massachusetts. Some carriers who want to continue serving the New England markets without bearing the operating costs of being New England-based may choose to relocate by moving their base of operations or simply by registering their vehicles outside of New England. Under the IRP, vehicles can be based anywhere – carriers do not even need to have a terminal in a state for it to qualify as its base state, just an office. This enables carriers to pay only fees based on their vehicle miles traveled in the New England states, which are likely to be considerably lower than the total of registration and excise fees that would otherwise be required. The states lose the registration fees and the lost excise tax revenues impact cities and towns.

Among the New England states, Maine is perceived as having a "user-friendly" approach to registration because it does not require property tax payment on vehicles registered, but not based in Maine and because of its relatively low registration fees. As one official noted, "when Maine changes its plates, freight car loads go out." This demonstrates that efforts by the states to provide a favorable business climate are acted upon by the motor carrier industry.

2.3.2 Methodology

A profile of the trucking industry in New England was developed through a review of publications and telephone interviews with various persons connected with the motor carrier industry in both the public and private sectors. A listing of the documents reviewed and the persons contacted is provided at the end of this chapter, with some exceptions, as follows: Some interviews were conducted with agency and motor carrier representatives in Maine, New Hampshire, and Vermont as part of an ongoing study on institutional barriers to the implementation of Intelligent Vehicle-Highway Systems (IVHS) technologies for commercial vehicle operations. Because those interviews were conducted on a "not for attribution" basis, the names of the interviewees are not provided. In addition, an extensive

statutory review was conducted of the motor carrier laws in those three states; the list of documents reviewed exclusively for that study is not provided.

It should be noted that basic information on the dimensions of the trucking industry, such as who the major carriers are, what commodities they are carrying, and the geographic scope of their operations, is not readily available. In many cases, anecdotal evidence must be relied upon, particularly with respect to identifying major carriers and centers of operation. Efforts were made to obtain the most recent available data on the industry, but the most current available data on truck registrations, uses, and characteristics dates back to the Census of Transportation in 1987; data from the 1990 Census will not be available until later this year.

2.3.3 Existing Conditions

In this section, an overview of the current state of the trucking industry in New England and individual states are provided.

The majority of intercity freight in New England moves by truck, either point-to-point or as part of goods movements by other modes of transportation. Truck movements are particularly important to the construction, manufacturing, transportation, and wholesale trade sectors, which together account for over 40 percent of the region's total employment. In addition to supporting the traditionally truck-dependent economic sectors, truck movements are important to supporting New England's strong service sectors, such as its health care, higher education, and tourism. The movement of freight by truck affects every economic sector and industry and is increasing in importance within New England.

New England

Freight Movements

New England freight movements include inbound and outbound raw materials as well as manufactured products, but the principal type of freight moved in New England is manufactured freight. As the economies of the six New England states grew in the 1980s, freight movement also grew – the total amount of manufactured freight transported in New England grew by 37 percent from 1982 to 1991 (see Table 2.2). Air, water, and rail carriers all grew in terms of total tonnage carried, but trucking registered the most significant increase in market share. The tonnage carried by truck rose by 65 percent (see Table 2.3), and truck transportation's share of manufactured freight moved to and from New England rose from 66 percent in 1982 to 80 percent in 1991, an increase of just over 20 percent; during the same period, the rail share dropped from 12 percent to six percent, waterborne movements dropped from 22 percent to 13 percent, and the air share remained stable at under 1 percent (see Table 2.4).

Massachusetts and Connecticut, the New England states with the largest populations and most commercial activity, together account for 60 percent of all manufactured freight transported in 1991 (see Table 2.5), but the importance of moving freight by truck is maintained throughout the region. For example, a 1990 survey revealed that 100 percent of

the 80 largest manufacturers in New England use trucks as part of their goods movement strategy; 85 percent move some goods by air, and 23 percent use some rail movements. Traditional manufacturing firms ship fewer, heavier loads, most of which move by truck; for example, metal fabricators and machine companies ship all of their product via truck. The high-tech manufacturers ship a significant amount of their low weight, high value freight via air; trucks move this time-sensitive product to airports in Boston, Manchester, and Warwick.

In addition to providing direct point-to-point service, the trucking industry also supports the movement of freight by rail, sea, and air. For example, the growth area for rail in New England is in intermodal containerized and piggybacked freight which are "truck-dependent." Unlike other U.S. regions, very few containers in New England are placed directly from ship onto rail cars for shipment without drayage by truck. The principal container facilities in New England are in Boston; trucks move these containers to their ultimate New England destination. Even goods which move primarily via air freight (i.e., highly perishable goods such as seafood, in addition to the high-tech products noted above) are transported to air cargo facilities by truck.

Truck Types and Uses

Approximately 40 percent of the trucks registered in New England in 1987 are used primarily for commercial activities; the remaining 60 percent are used primarily for personal transportation. Large trucks comprise only about 12 percent of the total (223,700 vehicles). (Large trucks exclude pickups, mini-vans, station wagons, utilities, panels, multistops, and walk-ins). Only nine percent (166,500 vehicles) weigh over 10,000 lbs., and just over four percent (80,200) are combination vehicles. Detail on the number of commercial vehicles and large trucks by state may be found in Table 2.6. These commercial trucks are used primarily in the construction, wholesale trade, service, for-hire, and agriculture sectors (see Table 2.7). Flatbed trucks, dump trucks, and vans together account for over 75 percent of large trucks in New England, although the distribution among these and other types varies by state (see Table 2.8).

During the period from 1982 to 1987, the amount of manufactured freight moving by truck in New England grew by 21 percent, while the number of New England-registered trucks used primarily for commercial activity of grew by only 16 percent. Increases in the number of New England-registered trucks were recorded in the construction, service/utility, and forestry/mining sectors, but the number of trucks used for manufacturing actually dropped by almost eight percent. This reflects the increase in the number of trucks operating in New England but based elsewhere, as well as some increase in the productivity of trucking operations.

Carrier Types and Operations

The trucking industry in New England includes for-hire carriers as well as private carriers, firms which own and operate their own vehicles. The largest manufacturers generally rely on for-hire common and contract carriers to move goods to the market place, while shipping most of their interplant freight in their own private fleets.

Private carriers move the majority of manufactured freight carried by truck in New England, accounting for 56 percent of total tonnage moved in 1991 (see Table 2.9). Major private carriers in New England include supermarket chains, manufacturers, newspapers, and dairies. Like their for-hire counterparts, some of these carriers haul special commodities in truckload quantities, usually between manufacturing plants or from manufacturing plants to warehouses. These fleets make shorter moves and more scheduled moves than for-hire carriers. In addition, some private distribution fleets haul general freight and special commodities in less-than-truckload quantities, typically with short-haul scheduled moves between warehouses and retail outlets. Private carriers also include non-ICC-regulated for-hire carriers and local rental/moving fleets.

In 1991, for-hire truckload carriers moved almost 41 percent of the total manufactured freight transported by truck in New England. These carriers haul general freight and special commodities in truckload quantities, usually in a single move directly from the shipper to the receiver. Most for-hire truckload carriers are either regional or long-haul carriers (i.e., transcontinental) which operate on irregular schedules determined by the demands of shippers and receivers.

Despite the small amount of total tonnage moved (just over three percent of total manufactured freight moved by truck in New England in 1991), the volume of product moved by for-hire less-than-truckload (LTL) carriers is tremendous. For-hire LTL carriers haul general freight in LTL quantities, usually combining freight from many shippers to achieve cost-effective operations. LTL carriers have two types of operations: a local pick-up and delivery operation running urban trucks on regular routes from a central terminal; and a line-haul operation running over-the-road trucks in relays from terminal to terminal across the country.

The other major group of carrier are the service fleets, which include utility company fleets, federal government vehicles, state and local highway department trucks, fire apparatus, etc. Generally, these fleets operate dedicated equipment from a local garage with irregular routes and schedules.

Connecticut

Freight Movements

Connecticut accounts for the second highest percentage of total manufactured freight transported into and out of New England, but the second lowest percentage of freight moved by truck. The largest industrial sector in Connecticut is the services sector, with education, insurance, and health service industries as major employers, but Connecticut generates the second largest amount of manufactured freight among the New England states (see Tables 2.4 and 2.5). A significant amount (up to 25 percent) of low weight, high value freight is moved by air from Connecticut; these shipments move by truck to airports in Hartford and Boston.

Truck Types and Uses

Connecticut ranks second only to Massachusetts in New England in the number of vehicles operated in commercial activity (167,500) and the number of large trucks (48,900).

Connecticut has the largest percentage of large trucks in the construction sector (35 percent) of the New England states. Other major uses of large trucks include trade (20 percent) and services (16 percent). Among the large trucks, dump trucks are the most common (25 percent) followed by flatbeds (23 percent) and vans (18 percent).

Operators

Major Connecticut-based for-hire carriers include Valleries, a southern New England LTL carrier; and R.J. Garrera and D.J. King, interstate cargo container carriers. Major private carriers include two grocery haulers, Stop and Shop and First National. National carriers with significant presence in Connecticut include Roadway, ABF, Watkins, Yellow, UPS, J.B. Hunt, Schneider, and National.

Activity Areas

In Connecticut, major carrier terminals and facilities are situated to serve New York city and points west of new England. These operations tend to be located just outside of major metropolitan areas, where costs are lower but access is good. In Connecticut, however, there is significant trucking activity in New Haven proper due to small carriers accessing petroleum at the New Haven Terminal, New England's largest oil terminal.

Maine

Freight Movements

In Maine, the total tonnage of manufactured freight transported into and out of the state grew only half as much (22 percent) as did the share of freight moved by truck (53 percent) from 1982 to 1991 (see Table 2.10). Major products hauled by truck in Maine include paper and other forest products, including wood mulch; potatoes; and seafood.

Truck Types and Uses

Commercial trucks in Maine are concentrated in the construction, agriculture, and trade sectors. Of the 100,900 Maine-registered vehicles used for commercial activities in 1987, 31,300 were large trucks. The large trucks are used primarily in the construction (30 percent), agriculture (21 percent), and trade (16 percent) sectors. Maine has the largest percentage of vehicles in the forestry/mining sector, 12 percent.

Operators and Activity Areas

The most significant for-hire carriers in Maine include Yellow Freight, Preston, J.B. Hunt; Schneider, Hartz, Pottles, Timberland, and C&J Transport. Of these carriers, Yellow and J.B. Hunt probably have the largest fleets (approximately 100 trucks each). Major trucking activity areas include metropolitan Portland, Augusta, Pittsfield, and Bangor.

Massachusetts

Freight Movements

Massachusetts accounts for nearly 37 percent of total inbound and outbound manufactured freight transported in New England in 1991, the largest share of all the New England states (see Table 2.5). During the period from 1982 to 1991, the total tonnage of manufactured

freight transported in Massachusetts grew by 40 percent, while the tonnage transported by truck grew by nearly 75 percent, and trucking's share of manufactured freight transported grew by nearly 17 percent (see Tables 2.2, 2.3, and 2.10).

The high-tech electronics industry was the single largest manufacturing employer in Massachusetts in 1987, having enjoyed significant growth during the 1980s. While high-tech business activity slows in Massachusetts, the biotech industry is positioned for growth, combining Massachusetts' competitive advantages in medical research and high-quality manufacturing. Perishable biotech products require special handling and just-in-time delivery that trucks can provide. A 1990 survey of the 10 largest biotech firms in Massachusetts found that they all rely exclusively on trucks for shipments and require access to air freight facilities; these ten firms generate a total of 225 truck trips each day.

Service firms represent the largest sector of the Massachusetts economy. These firms rely on trucks for deliveries of all supplies and equipment. The 10 largest hospitals in Massachusetts receive a total of nearly 200 truck shipments each day.

Truck Types and Uses

Massachusetts has the largest number of registered carriers and commercial vehicles of all the New England states. Among Massachusetts-registered trucks in 1987, 273,100 vehicles were operated in commercial activities, including 90,100 large trucks. These trucks are concentrated in the construction (31 percent), trade (24 percent) and services (17 percent) sectors. Flatbeds are the most common truck types, followed by vans and dump trucks (see Table 2.8).

Operators and Activity Areas

Metropolitan Boston and Worcester have the largest concentrations of terminals in Massachusetts. The major carrier in Massachusetts is UPS, which has several facilities, the largest of which is in Chelmsford. Federal Express has limited terminals in Massachusetts because New Hampshire is the base of most of their New England activities. Among the national players, Consolidated Freightways has a large springfield facility; Leaseway, the largest automobile mover in New England, has facilities near the railheads in Ayer and Framingham; and Yellow Freight and Roadway Express have significant Massachusetts operations.

Major for-hire carriers based in Massachusetts include Hallamore (Boston/Abington), which operates cranes and moves specialized equipment; R.M. Sullivan (Holliston), an LTL operator with a Springfield terminal; Crystal Motors (Wakefield), an LTL operator; J.P. Noonan (West Bridgewater), a fuel carrier; T.F. Boyle (Billerica terminal), which moves classified military hardware; Shaughnessy and Ahearn (South Boston), crane and specialized equipment carrier; Houghton Chemical (Allston), a chemical carrier with interstate and intrastate operations; and Casey and Hayes (South Boston), movers.

New Hampshire

Freight Movements

New Hampshire actually generates more outbound manufactured freight than moves into the state (see Table 2.9). Trucks moved nearly 100 percent of the outbound freight manufactured in New Hampshire in 1991; this freight includes high-tech electronic machinery and instruments, along with paper and metal products. The metal fabricators and paper companies ship nearly all of their product by truck. Even the significant portion of the high-tech freight which moves by air reaches the airports in Manchester and Boston by truck.

Manchester Airport has the potential to expand its air/truck intermodal operations by virtue of its central New England location. Airborne, Federal Express, and UPS fly directly to Manchester, but highway access to the Manchester airport is a continuing problem that inhibits the growth of air/truck operations.

Tourism is New Hampshire's largest industry; many truck trips are devoted to supplying hotels, restaurants, and other tourism-related businesses. For example, a 1990 survey of the ten largest resorts in the state indicated that in total, they receive an average of 60 deliveries of goods and services by truck each day.

Truck Types and Uses

Of New Hampshire's registered trucks in 1987, 42 percent (77,500 vehicles) were engaged in business activities, including 25,200 large trucks. As in the other New England states, the most common use of large commercial vehicles is in the construction industry (26 percent); unlike the other states, the second-largest concentration of large trucks in New Hampshire is in for-hire activities (16 percent), followed by trade (15 percent) and agriculture (14 percent). Also unlike the other states, dump trucks are the most common type (29 percent) followed by flatbeds and vans (28 percent each).

Operators and Activity Areas

The major for-hire carriers based in New Hampshire include several regional LTL carriers – BSP (based in Londonderry), Ross Express (Penecook), and State Transportation (Portsmouth). Another major LTL carrier, Nashua Motor Express (Nashua) covers the Mid-Atlantic as well as the New England region. The for-hire carriers operating the largest numbers of vehicles in the state are Decato (Lebanon) and Courrier (Gorham). Major private fleets include Associated Grocers of New England (Manchester); Cotter & Co. (Manchester), Pike (Tilton); and Federal Express (terminals in Manchester, Portsmouth, Keene, Laconia, and Lebanon).

Major trucking activity centers are Manchester and Nashua. Much of the traffic is intrastate; for example, Ross Express, the state's second largest carrier, does the majority of its business within New Hampshire. The major trucking thoroughfare is the 17-mile section of I-95 within New Hampshire.

Rhode Island

Freight Movements

The share of manufactured freight moved by truck in Rhode Island in 1991 was under 70 percent, the smallest share within New England states. Trucks moved only 57 percent of total inbound manufactured freight to Rhode Island in 1991, but moved 85 percent of the outbound tonnage (see Table 2.9). The total amount of manufactured freight transported in Rhode Island grew by over 85 percent between 1982 and 1991, but the tonnage transported by truck nearly tripled (see Tables 2.2 and 2.3).

There is significant intermodal goods movement involving both rail/truck and air/truck combinations. For example, in 1989 approximately 95,000 automobiles were shipped to Rhode Island's two principal ports, Providence and Davisville. Moving these vehicles out of the port requires 200 truck loads per week. With respect to air, the volume of air freight leaving T.F. Green Airport was 10,500 tons in 1988; this freight is moved by truck between Rhode Island shippers/receivers and the airport.

Truck Types and Uses

Of Rhode-Island registered trucks in 1987, 45,200 vehicles were engaged in commercial activities; large trucks numbered 14,700. The Rhode Island economy is dominated by the manufacturing and construction industries which rely heavily on trucks for product movement. Of the New England states, Rhode Island has the second largest percentage of trucks dedicated to construction (32 percent), with the wholesale and retail trade accounting for almost as large a share (31 percent). Flatbeds dominate in Rhode Island, followed by vans and dump trucks (see Table 2.8).

Operators

The major for-hire carriers based in Rhode Island include a group of national LTL carriers: C-Line (Warwick-based), HNN (Warwick), and Paul Arpin Van Lines (East Greenwich); and two LTL carriers with operations focused on the Northeast, DNN (Woonsocket) and Danis Transportation (Pawtucket). Major private carriers include Hudson Liquid Asphalts (Providence), with operations throughout the region; Macera & Martini (Johnston), a southern New England fuel distributor; and Coastal Refrigeration (Cranston), also distributing throughout New England.

Activity Areas

Rhode Island is located more strategically to serve Massachusetts and northern New England than is Connecticut. Most distributors are concentrated around Providence with very few in the south near Westerly. Hudson Liquid Asphalts is the only large distributor in Providence with a barge unloading facility at the port.

Vermont

Freight Movements

Like New Hampshire, Vermont generates more outbound manufactured freight than comes inbound. Vermont also has the smallest share of total inbound and outbound freight, accounting for only 3.6 percent of New England's total (see Table 2.5). However,

the tons of manufactured freight carried by truck in Vermont more than doubled during the 1982-1991 period (see Table 2.3). Vermont's manufacturing sector includes high-tech electronic machinery and instrument manufacturing along with with traditional machinery, wood, food, and metal products. All of the state's principal agricultural products are moved by trucks, including fluid milk, Vermont's largest and highest value crop; maple syrup; apples; and Christmas trees.

The large tourist industry in Vermont relies heavily on trucking for goods and supplies deliveries. A 1990 survey of the 10 largest hotels and resorts found that in total they received 80 truck shipments per day.

Truck Types and Uses

Of the trucks registered in Vermont in 1987, 49,000 vehicles are used primarily in commercial activity, including 13,500 large trucks. Commercial vehicles are concentrated in the construction (25 percent), agriculture (24 percent) and trade (20 percent) sectors, with seven percent are dedicated to forestry and mining. Flatbeds dominate the large truck fleet in Vermont more than in any other New England state, accounting for 40 percent of these vehicles (see Table 2.8).

Operators and Activity Areas

Most Vermont-based fleets tend to be small, averaging between five and 15 trucks, but the dairy fleets tend to have 30-40 trucks. Most of the major national LTL carriers, such as Yellow Freight, have some kind of terminal or breakbulk facility in Vermont. The major centers of trucking activity include the areas of White River Junction, Burlington, and central Vermont.

2.3.4 Issues for the Future

A coordinated regional response to the issues and pressures facing the trucking industry is essential to ensuring that motor carriers will be able to continue providing the freight movement services that are critical to the growth and competitiveness of the regional economy. Some of these issues are important today, but all of them have significant implications for the future of the industry.

Competitive Pressures

Issue

Since the deregulation of motor carrier industry in 1980, it has evolved from a highly regulated industry to an extremely competitive one. Shipping costs have dropped, and the industry has undergone a massive reorganization. While the motor carrier industry as a whole has grown at about the same rate as the gross national product, profit margins in today's industry are relatively small and profits are generally low compared to the profit margins realized prior to deregulation. The regulated, for-hire segment of the industry has undergone the most change, but deregulation has also forced parallel changes in the management of private fleets.

Implication

The region as a whole, as well as its individual states, should be sensitive to the needs of the motor carrier industry when revisiting the issues of taxation, user fees, and regulations. High operating costs, taxes, and fees are already straining New England-based carriers. In 1987, the most recent year for which data are available, the trucking industry accounted for 424,722 employees, or approximately one out of every 13 employed New England workers. The preservation of this employment depends on ensuring support for the business of trucking.

Increasing Emphasis on Customer Service

Issue

The pressures and opportunities of the global marketplace are forcing many U.S. companies to change the way they do business. Many of the changes, such as the introduction of just-in-time manufacturing and distribution systems, and an increased emphasis on quality and customer service, directly affect motor carrier operations, particularly for long-haul truckload carriers. For example, as manufacturing and distribution industries seek to reduce inventory carrying costs by implementing just-in-time production and retailing systems, they are asking carriers to provide more frequent and timely deliveries to resupply assembly lines and restock retail shelves.

Implication

In order to provide the desired level of customer service, motor carriers must be ensured timely access to economic centers and coordinated action to alleviate congestion. The implications of access and routing restrictions that hinder trucks' access to shippers and receivers must be carefully considered. For example, in downtown Boston, limits on the time in which a commercial vehicle may be parked in one spot make it impossible for some LTL pick-up and delivery services to complete their business without receiving a citation. Last year, UPS alone paid a total of over $300,000 in overtime parking fines in Boston, and Federal Express projects that its fines may surpass $400,000 in 1994; eventually, these costs may be passed along to customers, increasing the overall cost of doing business in New England.

Increasing Congestion

Issue

In 1981, the FHWA estimated that 16 percent of national urban interstate miles were severely congested; by 1988, over 30 percent were so classified. Congestion has a significant impact on trucking because one-third of all truck-miles of travel occurs in large urban areas, such as Boston, with an estimated two-thirds of that mileage on freeways. As congestion increases, so does the competition between trucks and automobiles for use of the available capacity despite the fact that peak hours of travel differ for truck trips and for general traffic. Competition for highway capacity among all highway users is likely to intensify as travel demand increases and the provisions of the Clean Air Act force metropolitan areas not meeting air quality standards to reduce VMT and emissions.

In addition, the trucking industry is concerned about restrictions on truck access, movements, and fuel use that may be developed as part of these systems in response to air quality concerns. For example, a proposal is being considered in New Hampshire to require the mandatory use of alternative fuels for vehicles weighing between 8,000 and 26,000 lbs.; such proposals are not looked upon favorably by the trucking industry.

An estimated 60 percent of congestion results from accidents and incidents; the remaining 40 percent is recurring congestion due to an excess number of vehicles. One industry response to congestion has been to introduce congestion information into routing and scheduling decision. Recently, the American Trucking Association (ATA) Foundation sponsored a demonstration with TRANSCOM, a traffic information clearinghouse set up by 15 public agencies in the New York/New Jersey metropolitan area to provide current information about construction delays and highway incidents. The TRANSCOM demonstration essentially was an urban IVHS program geared toward automobile commuters, but the ATA and TRANSCOM cooperated to provide a test group of motor carriers with pagers and facsimile machines so that up-to-the-minute traffic information was available to dispatchers. Test participants reported that the traffic information saved time for their drivers, provided that alternate routes were available. Driver acceptance was high, but dispatchers were less enthusiastic. The dispatchers appreciated the information, but were unable to organize and process the large volumes of traffic information in a timely fashion.

This demonstration (as well as related studies of highway incident management programs) point up at least two problems that must be addressed, preferably on a regional level, before fleets can make effective use of congestion information developed as part of urban IVHS programs for fleet management:

- Trucks have special routing constraints, so that information that suffices for commuters may be inadequate for trucks. For example, alternate routes and diversions around incidents must be safe for trucks (i.e., have adequate overhead clearance, bridge capacity, and turning radii, for example) and must comply with local noise, access, and hazardous materials movement regulation.

- Trucks need information about congestion conditions on a broader geographic scale than a single urban commuting area, which is the range of most urban IVHS programs. Most trucks operate within a 50- to 200-mile radius of their terminals, a distance that often falls outside or between the coverage of individual urban IVHS programs.

Implication

Any efforts to develop urban IVHS systems for traffic management and traveler information in the region should consider the needs of the trucking industry. Efforts that are limited to metropolitan areas, for example, are unlikely to provide the breadth of coverage required for freight movements. The congestion management systems required by the ISTEA also provide a mechanism for incorporating the needs of the trucking industry into making coordinated decisions about congestion alleviation.

Resistance to New Ways of Doing Business

Issue

Some observers believe that the combination of institutional resistance – conservatism on the parts of both public agencies and motor carriers – plus infrastructure considerations – old roads, narrow turns, granite curbstones – will substantially impede the region's ability to implement procedural or technological innovations that may improve the efficiency with which motor carrier regulations and enforcement are administered. On a national level, in individual states, and in consortia of states, IVHS/CVO (commercial vehicle operations) programs are being developed to increase the efficiency and reduce the cost of regulatory compliance (and vehicle movements) by using technology. Under a fully realized IVHS/CVO program, carriers could obtain all credentials and permits in one electronic transaction with a single state ("one-stop shopping") and be able to cross state borders without stopping repeatedly for the purchase or verification of credentials, size and weight compliance, and safety status ("transparent borders").

All of the New England states are in various stages of examining their interest in these technologies, as well as identifying the non-technical, institutional barriers to the implementation of these technologies.

For example, a number of state and carrier officials in New England have expressed an interest in implementing technologies or procedural changes that will reduce delays at weigh stations; improve the consistency of enforcement; streamline the process of credentials application, issuance, and verification; and improve the efficiency with which information is communicated, among agencies within a state as well as among states in the region. In the interviewees' opinion, the likely barriers to implementing such changes include "the established traditions in New England," likely carrier resistance to state-mandated investment in technology, lack of available resources in both the public and private sectors, poor communications among intrastate agencies, and inconsistent enforcement practices. The perception is that these barriers are more difficult to overcome than they may be in other parts of the country.

Implication

It is important that the New England states work together in the development of IVHS/CVO programs that will meet the needs of the public and private sector motor carrier interests. Development of a regional system will go a long way towards alleviating fears that incompatible technologies will require multiple, wasteful investments for both the states and the carriers. As part of these efforts, the states should work towards increasing the uniformity of their motor carrier regulations and improving the efficiency with which the credentials process is administered. In a time of shrinking resources on the public sector side and increasing pressure to cut costs on the part of the motor carriers, efforts to streamline the regulatory process are needed for increasing productivity on both sides.

Regional actions to alleviate the effects of congestion, ensure truck access to economic centers during business hours, increase the uniformity of motor carrier regulation and enforcement, develop coordinated responses to managing and alleviating the effects of

congestion that are sensitive to the needs of the trucking industry, and work towards the implementation of a cost-effective IVHS/CVO system that will generate benefits for both the states and the carriers and will be compatible with other national and regional systems will help to ensure the viability of efficient and effective freight movements in New England.

2.4 Intercity Buses

In Chapter 2.0 of the NETI Inventory report, Section 2.2 discussed the intercity bus service available in New England. Intercity bus service is defined as service which has limited stops over fixed routes connecting two or more urban areas not in close proximity, and has the capacity for transporting baggage carried by passengers and which makes meaningful connections with scheduled intercity bus service to more distant points. As such, intercity service does not include commuter, charter or local bus service. The major intercity bus companies within New England are Bonanza, Concord Trailways, Greyhound, Peter Pan, Plymouth and Brockton, and Vermont Transit.

2.4.1 Historic Trends

In the past three decades, intercity bus service has been on the decline. In 1963, 30 percent of the national intercity travel market was retained by buses. By 1981, this portion dropped to 12 percent. In 1982, the Bus Regulatory Reform Act reduced the authority of the Interstate Commerce Commission and state agencies and allowed bus companies greater flexibility to set fares, enter markets and discontinue unprofitable service. The intercity bus market continued to weaken throughout the country, however, with less than 6,000 locations being served in 1991, compared with 17,000 locations in 1968 and 12,000 locations in 1982. In 1987, Greyhound bought Trailways increasing its national market share, but in 1990 encountered difficulty with a lengthy driver strike and subsequent bankruptcy. A $22 million settlement was rendered with the drivers. In 1991, the company reentered the market with fewer routes and buses, creating an opportunity for other carriers to enter the market.

Subsequent to the 1982 Act, a variety of state assistance programs within New England were established to ensure the continuation of key bus service. Maine and Massachusetts provide direct operating assistance programs and vehicle assistance programs primarily through reduced cost leasing and long-term purchases. Massachusetts is currently the only New England state which provides assistance for building and remodeling bus terminals.

In 1991, for the first time, federal funds were made available for rural intercity bus service through the ISTEA Section 18(i) program. Section 18(i) enables states to designate five percent of 1992 Federal funds to the improvement of intercity bus service. This amount increases to 10 percent for 1993 and to 15 percent for 1994 and years thereafter. Funds will

be available to plan and market intercity bus routes, build shelters and joint-use stops and depots, and coordinate rural connections between small transit operations and intercity bus carriers. With these funds, the states can now offer private rural carriers additional money. Other capital and operating projects that support rural intercity bus service will also be eligible. Spending of these funds is not required if the Governor certifies that "the intercity bus service needs of the state are being adequately met." It is this clause which permits states to individually evaluate if and where their Section 18(i) funds should spent.

2.4.2 Current Trends and Concerns

Intercity bus service competes with a number of modes throughout the region. The automobile offers the greatest competition in the rural areas of northern New Hampshire, Vermont, and Maine; western Massachusetts; and northwest Connecticut. In more densely populated areas, buses compete with the automobile, vanpools, commuter rail and other transit options.

Carriers within the region indicate that for the most part fares have not recently changed on their routes. Bus companies report a modest one percent to four percent annual increase in intercity ridership and indicate the trend is likely to continue. Commuter-oriented routes are experiencing the highest ridership growth. For instance, Concord Trailways reported that its Boston bound commuter ridership has increased 25 percent in the last few years. This growth is due in part to new service provided from a park and ride lot in Londonderry, NH, into Boston. Another such lot is currently planned for Concord, NH. Facilities of this type play a crucial role in encouraging commuters to opt for bus service and their success influence how bus service is perceived. Carriers are concerned about the passenger's perception of bus service and are determined to improve their image.

A major concern of carriers is the competition introduced when new rail service is initiated and consequently reduces bus ridership on similar routes. Carriers claim they can compete in an open market with commuter and long-haul rail services, but cannot compete if fares on those services are artificially held below the market rate. (While bus companies contribute to highway maintenance and construction through the fuel tax, the amount contributed is not necessarily equal to the true cost of the benefit received.) When the Providence to Boston commuter service was introduced in 1988, Bonanza Bus Lines experienced a ridership decrease on its Providence to Boston routes – a permanent loss which has not been recaptured. The restoration of the Old Colony commuter line, south of Boston, will affect Plymouth and Brockton bus services in the area. Bus carriers which are impacted by subsidized urban services are often the same ones which offer rural-oriented intercity connections. As such, the economic consequences of losing riders within the urban market may affect the stability of rural service. However, new rail services may open up potential new markets for bus feeder services.

While ISTEA Section 18(i) funds will inject additional money to the intercity system, the amounts are limited. States are able to opt out of spending Section 18 funds on intercity bus services if the Governor certifies that "needs are being met." States had anticipated that intercity bus funds would be in addition to ISTEA Section 18 funds, not part of the standard

formula grant. For example, Maine is eligible to receive about $200,000 in 1995 for intercity bus subsidies – an amount less than the purchase price of one motor coach. This year, Massachusetts designated a total of $50,000 to Plymouth and Brockton and Peter Pan Bus companies. Vermont is planning a intercity bus demand study in 1994. The carriers will use the funds on routes in the western part of the state and Cape Cod to construct bus shelters and market service, through increased advertisement. This emphasis on short-term marketing is well placed. Existing routes can accommodate more riders and targeted advertising can attract them. As both awareness and the amount of these funds increase, the impact should be more significant.

Under the American Disabilities Act (ADA), which requires equitable accessibility to transportation facilities for the disabled, motorized coach carriers will be required to make their vehicles totally accessible by 1997. Proponents anticipate that the ADA will enhance the connections between local transit systems and intercity bus services. Bus carriers are concerned, however, that the existing wheelchair lift technologies have not overcome all of the operational problems particular to buses with luggage/package compartments.

The emphasis of short-term strategies is to increase ridership on existing routes. Since all urban areas in New England are served by intercity routes from a variety of rural areas, no new service is envisioned at this time. Some carriers offer improved passenger amenities, such as in-coach videos and beverages, and underscore their effectiveness in maintaining ridership. Carriers believe that their ridership volume is dependent on the reliability of the service, but need to rely on the economic strength of the region for their continued growth.

The future of bus travel is dependent upon how it services various peoples and interacts with other modes throughout New England. Major bus activity centers, which are served by several bus routes, have been identified in the region and provide the opportunity to transfer to other intercity services. Boston, accessible by bus from most other cities in New England, serves as the central hub of intercity bus activity for the entire region. In northern New England, White River Junction, on the New Hampshire/Vermont border is a transfer point for services from the north feeding south into Boston and Springfield. Smaller hubs include Concord, NH and Bangor, ME. In southern New England, Providence, RI, and Hartford, CT, serve as major hubs funneling service east to Cape Cod, north to Boston and Springfield and south toward New York City. The existence of intermodal transfer facilities would allow continued development of the intercity bus market. For example, the 1994 completion of the South Station Transportation Center in Boston will provide a common terminal for bus services and adjoining access to Northeast Corridor Amtrak and MBTA commuter rail service. Consolidating access from intercity bus services to other modes would enhance the service by providing multiple transfer options.

The provision of High Occupancy Vehicle (HOV) lanes along congested highway can provide a significance advantage to bus companies. As described earlier in this chapter, Massachusetts and Connecticut (which experience the most highway congestion in the region) are actively pursuing such strategies.

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Tables

Table 2.1 VMT Growth Rates for New England States

State	Category	1990 Daily VMT	1996 Daily VMT	Change	Percent Change 1990 to 1996	Average Annual Growth
New Hampshire	Statewide	30,620,000	35,459,000	4,839,000	15.80%	2.50%
Massachusetts	Statewide	126,508,000	146,238,000	19,730,000	15.60	2.44
Rhode Island	Statewide	21,098,576	22,663,982	1,565,406	7.42	1.20
Connecticut	Statewide	72,072,860	78,686,300	6,613,440	9.18	1.47

State	Category	1990 Annual VMT	1996 Annual VMT	Change	Percent Change 1990 to 1996	Average Annual Growth
Maine	Statewide	11,730,000,000	13,490,000,000	1,753,000,000	14.94%	2.35%

State	Category	Percent Change 1992 to 2012	Average Annual Growth
Vermont	Interstate Hwys	57.00%	2.28%

Sources: NH: 1991-1996 VMT Forecasting, NHDOT Bureau of Transportation Planning, August 31, 1993.
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Table 2.2 Total New England Manufactured Freight Transported by State, 1982 and 1991 Annual Tons

State	1982 Tons	1991 Tons	Percent Change
Connecticut	41,394,925	58,112,973	40.4%
Maine	43,232,828	52,846,708	22.2
Massachusetts	71,132,925	92,103,127	29.5
New Hampshire	12,159,026	20,232,218	66.4
Rhode Island	9,502,372	17,612,364	85.3
Vermont	4,368,949	8,798,005	101.4
Total	**181,791,025**	**249,705,395**	**37.4%**

Source: American Trucking Associations Foundation; Reebie Associates, Transearch Database, Greenwich, Connecticut.

Table 2.3 Total Inbound and Outbound Manufactured Freight Transported by Truck in New England 1982 and 1991 Annual Tons

State	1982 Tons	1991 Tons	Percent Change
Connecticut	25,084,433	43,690,983	74.2%
Maine	28,287,106	43,310,367	53.1
Massachusetts	50,306,782	76,075,945	51.2
New Hampshire	9,894,390	17,607,110	78.0
Rhode Island	4,070,633	12,104,219	197.4
Vermont	3,336,726	7,455,738	123.4
Total	**120,980,070**	**200,244,362**	**65.5%**

Source: American Trucking Associations Foundation; Reebie Associates, Transearch Database, Greenwich, Connecticut.

Table 2.4 Inbound and Outbound New England Manufactured Freight by State and by Mode, 1991

		Moved by Truck		Moved by Air		Moved by Water		Moved by Rail			Total Rail	Intermodal
	Total Tons	Sum of Truck	Percent of Total Tons	Tonnage	Percent of Total Tons	Tonnage	Percent of Total Tons	Carload	Intermodal	Total	Percent of Total Tons	Percent of Total Tons
Connecticut												
Inbound	33,557,562	20,382,969	60.7%	22,744	0.1%	10,933,835	32.6%	2,207,276	10,738	2,218,014	6.6%	0.0%
Outbound	24,555,411	23,308,014	94.9%	17,908	0.1%	1,061,410	4.3%	155,642	12,446	168,088	0.7%	0.1%
Total	**58,112,973**	**43,690,983**	**75.2%**	**40,652**	**0.1%**	**11,995,245**	**20.6%**	**2,362,918**	**23,184**	**2,386,102**	**4.1%**	**0.0%**
Maine												
Inbound	27,970,533	21,914,383	78.3%	5,626	0.0%	3,306,671	11.8%	2,696,000	47,853	2,743,853	9.8%	0.2%
Outbound	24,876,175	21,395,984	86.0%	3,414	0.0%	177,944	0.7%	3,293,281	5,552	3,298,833	13.3%	0.0%
Total	**52,846,708**	**43,310,367**	**82.0%**	**9,040**	**0.0%**	**3,484,615**	**6.6%**	**5,989,281**	**53,405**	**6,042,686**	**11.4%**	**0.1%**
Massachusetts												
Inbound	52,094,903	38,609,108	74.1%	55,686	0.1%	9,302,351	17.9%	3,067,949	1,059,809	4,127,758	7.9%	2.0%
Outbound	40,008,224	37,466,837	93.6%	58,037	0.1%	1,202,755	3.0%	523,310	757,285	1,280,595	3.2%	1.9%
Total	**92,103,127**	**76,075,945**	**82.6%**	**113,723**	**0.1%**	**10,505,106**	**11.4%**	**3,591,259**	**1,817,094**	**5,408,353**	**5.9%**	**2.0%**
New Hampshire												
Inbound	9,128,792	6,593,477	72.2%	2,607	0.0%	1,784,640	19.5%	701,046	47,022	748,068	8.2%	0.5%
Outbound	11,103,426	11,013,633	99.2%	2,746	0.0%	25,271	0.2%	61,776	0	61,776	0.6%	0.0%
Total	**20,232,218**	**17,607,110**	**87.0%**	**5,353**	**0.0%**	**1,809,911**	**8.9%**	**762,822**	**47,022**	**809,844**	**4.0%**	**0.2%**
Rhode Island												
Inbound	10,321,533	5,891,111	57.1%	2,058	0.0%	4,298,155	41.6%	130,209	0	130,209	1.3%	0.0%
Outbound	7,290,831	6,213,108	85.2%	670	0.0%	1,076,833	14.8%	220	0	220	0.0%	0.0%
Total	**17,612,364**	**12,104,219**	**68.7%**	**2,728**	**0.0%**	**5,374,988**	**30.5%**	**130,429**	**0**	**130,429**	**0.7%**	**0.0%**
Vermont												
Inbound	4,181,205	3,248,987	77.7%	224	0.0%	150,244	3.6%	773,818	7,932	781,750	18.7%	0.2%
Outbound	4,616,800	4,236,751	91.8%	0	0.0%	0	0.0%	374,083	5,966	380,049	8.2%	0.1%
Total	**8,798,005**	**7,485,738**	**85.1%**	**224**	**0.0%**	**150,244**	**1.7%**	**1,147,901**	**13,898**	**1,161,799**	**13.2%**	**0.2%**
Total New England												
Inbound	137,254,528	96,640,035	70.4%	88,945	0.1%	29,775,896	21.7%	9,576,298	1,173,354	10,749,652	7.8%	0.9%
Outbound	112,450,867	103,634,327	92.2%	82,775	0.1%	3,544,213	3.2%	4,408,312	781,249	5,189,561	4.6%	0.7%
Total	**249,705,395**	**200,274,362**	**80.2%**	**171,720**	**0.1%**	**33,320,109**	**13.3%**	**13,984,610**	**1,954,603**	**15,939,213**	**6.4%**	**0.8%**

Source: American Trucking Associations Foundation; Reebie Associates, Transearch Database, Greenwich, Connecticut.

Table 2.5 Total Tons of Inbound and Outbound Manufactured Freight Transported by State in New England, 1991

State	Inbound Tons	Outbound Tons	Total Tons	Percent of New England Tons
Connecticut	33,557,562	24,555,411	58,112,973	23.3%
Maine	27,970,533	24,876,175	52,846,708	21.2
Massachusetts	52,094,903	40,008,224	92,103,127	36.9
New Hampshire	9,128,792	11,103,426	20,232,218	8.1
Rhode Island	10,321,533	7,290,831	17,612,364	7.1
Vermont	4,181,205	4,616,800	8,798,005	3.5
Total	**137,254,528**	**112,450,867**	**249,705,395**	**100.0%**

Source: American Trucking Associations Foundation; Reebie Associates, Transearch Database, Greenwich, Connecticut.

Table 2.6 Truck Registrations in New England by State, 1987

	Total Trucks	Commercial Vehicles		Large Trucks[1]	
		Number	Percent of Total	Number	Percent of Total
Connecticut	438,200	167,500	38.2%	48,900	11.2%
Maine	258,800	100,900	39.0	31,300	12.1
Massachusetts	673,700	273,100	40.5	90,100	13.4
New Hampshire	184,500	77,500	42.0	25,200	13.7
Rhode Island	119,700	45,200	37.8	14,700	12.3
Vermont	130,700	49,000	37.5	13,500	10.3
Total	**1,805,600**	**713,200**	**39.5%**	**223,700**	**12.4%**

[1] Excludes pickups, minivans, station wagons, utilities, parcels, multi-stops, and walk-ins.

Source: American Trucking Associations Foundation, unpublished data.

Table 2.7 Percent Distribution of Large Commercial Trucks in the New England States by Major Use, 1987

	CT	ME	MA	NH	RI	VT
Construction	35%	30%	31%	26%	32%	25%
Trade (wholesale and retail)	20%	16%	24%	15%	31%	20%
Service/Utility	16%	6%	17%	11%	9%	12%
For-Hire	8%	10%	11%	16%	10%	10%
Agriculture	9%	21%	3%	14%	7%	24%
Manufacturing	4%	3%	6%	1%	7%	2%
Forestry/Mining	3%	12%	3%	1%	3%	7%
Daily Rental	5%	2%	4%	1%	2%	1%
Other	0%	0%	0%	18%	0%	0%

Note: Totals may not add to 100 percent due to rounding.

Source: American Trucking Associations Foundation, unpublished data.

Table 2.8 Percent Distribution of Large Commercial Trucks in the New England States by Body Type, 1987[1]

	Percent of Large Trucks by Body Type						Total New England
	CT	ME	MA	NH	RI	VT	
Flatbed	33%	35%	28%	28%	33%	40%	31%
Dump	25%	23%	24%	29%	21%	27%	25%
Van	18%	21%	25%	28%	22%	12%	21%
Tank	5%	7%	7%	4%	9%	8%	7%
Pole/Logger	0%	4%	0%	0%	0%	1%	NA
Other	29%	10%	16%	11%	15%	12%	16%

1 New Hampshire and Connecticut data are for 1982.

Source: U.S. Department of Transportation, 1982 Connecticut Census of Transportation; 1982 New Hampshire Census of Transportation; 1987 Maine Census of Transportation; 1987 Massachusetts Census of Transportation; 1987 Rhode Island Census of Transportation; 1987 Vermont Census of Transportation.

Table 2.9 Tons of Inbound and Outbound Manufactured Freight Transported by Truck in New England by Carrier Type, 1991

	For-Hire Truckload		For-Hire LTL		Private			
	Tonnage	Percent of Total Truck	Tonnage	Percent of Total Truck	Tonnage	Percent of Total Truck	Sum of Truck	Truck as Percent of Total Tons
Connecticut								
In	7,133,310	35.0%	831,338	4.1%	12,418,321	60.9%	20,382,969	60.7%
Out	12,513,553	53.7%	689,001	3.0%	10,105,460	43.4%	23,308,015	94.9%
Total	**19,646,863**	**45.0%**	**1,520,339**	**3.5%**	**22,523,781**	**51.6%**	**43,690,983**	**75.2%**
Maine								
In	7,589,876	34.6%	379,618	1.7%	13,944,889	63.6%	21,914,383	78.3%
Out	7,671,912	35.9%	196,805	0.9%	13,527,267	63.2%	21,395,984	86.0%
Total	**15,261,788**	**35.2%**	**576,423**	**1.3%**	**27,472,156**	**63.4%**	**43,310,367**	**82.0%**
Massachusetts								
In	16,414,142	42.5%	1,753,850	4.5%	20,441,116	52.9%	38,609,108	74.1%
Out	17,001,075	45.4%	1,491,727	4.0%	18,974,035	50.6%	37,466,837	93.6%
Total	**33,415,217**	**43.9%**	**3,245,577**	**4.3%**	**39,415,151**	**51.8%**	**76,075,945**	**82.6%**
New Hampshire								
In	1,928,955	29.3%	306,171	4.6%	4,358,351	66.1%	6,593,477	72.2%
Out	3,749,142	34.0%	232,253	2.1%	7,032,238	63.9%	11,013,633	99.2%
Total	**5,678,097**	**32.2%**	**538,424**	**3.1%**	**11,390,589**	**64.7%**	**17,607,110**	**87.0%**
Rhode Island								
In	2,269,902	38.5%	261,629	4.4%	3,359,580	57.0%	5,891,111	57.1%
Out	1,999,560	32.2%	231,130	3.7%	3,982,418	64.1%	6,213,108	85.2%
Total	**4,269,462**	**35.3%**	**492,759**	**4.1%**	**7,341,998**	**60.7%**	**12,104,219**	**68.7%**
Vermont								
In	1,320,058	40.6%	179,683	5.5%	1,749,246	53.8%	3,248,987	77.7%
Out	1,724,266	40.7%	144,435	3.4%	2,368,050	55.9%	4,236,751	91.8%
Total	**3,044,324**	**40.7%**	**324,118**	**4.3%**	**4,117,296**	**55.0%**	**7,485,738**	**85.1%**
Total New England								
In	36,656,243	37.9%	3,712,289	3.8%	56,271,503	58.2%	96,640,037	70.4%
Out	44,659,508	43.1%	2,985,351	2.9%	55,989,468	54.0%	103,634,330	92.2%
Total	**81,315,751**	**40.6%**	**6,697,640**	**3.3%**	**112,260,971**	**56.1%**	**200,274,365**	**80.2%**

Table 2.10 Change in Share of Total Inbound and Outbound Manufactured Freight Transported by Truck in New England, 1982 to 1992

State	Percent of Manufactured Freight Moved by Truck 1982	Percent of Manufactured Freight Moved by Truck 1991	Percent Change 1982 to 1991
Connecticut	60.6%	75.2%	24.1%
Maine	65.4	82.0	25.3
Massachusetts	70.7	82.6	16.8
New Hampshire	81.4	87.0	6.9
Rhode Island	42.8	68.7	60.4
Vermont	76.4	85.1	11.4
Total	**66.5%**	**80.2%**	**20.5%**

Source: American Trucking Associations Foundation; Reebie Associates, Transearch Database, Greenwich, Connecticut.

Figures

Figure 2.1 New England National Highway System

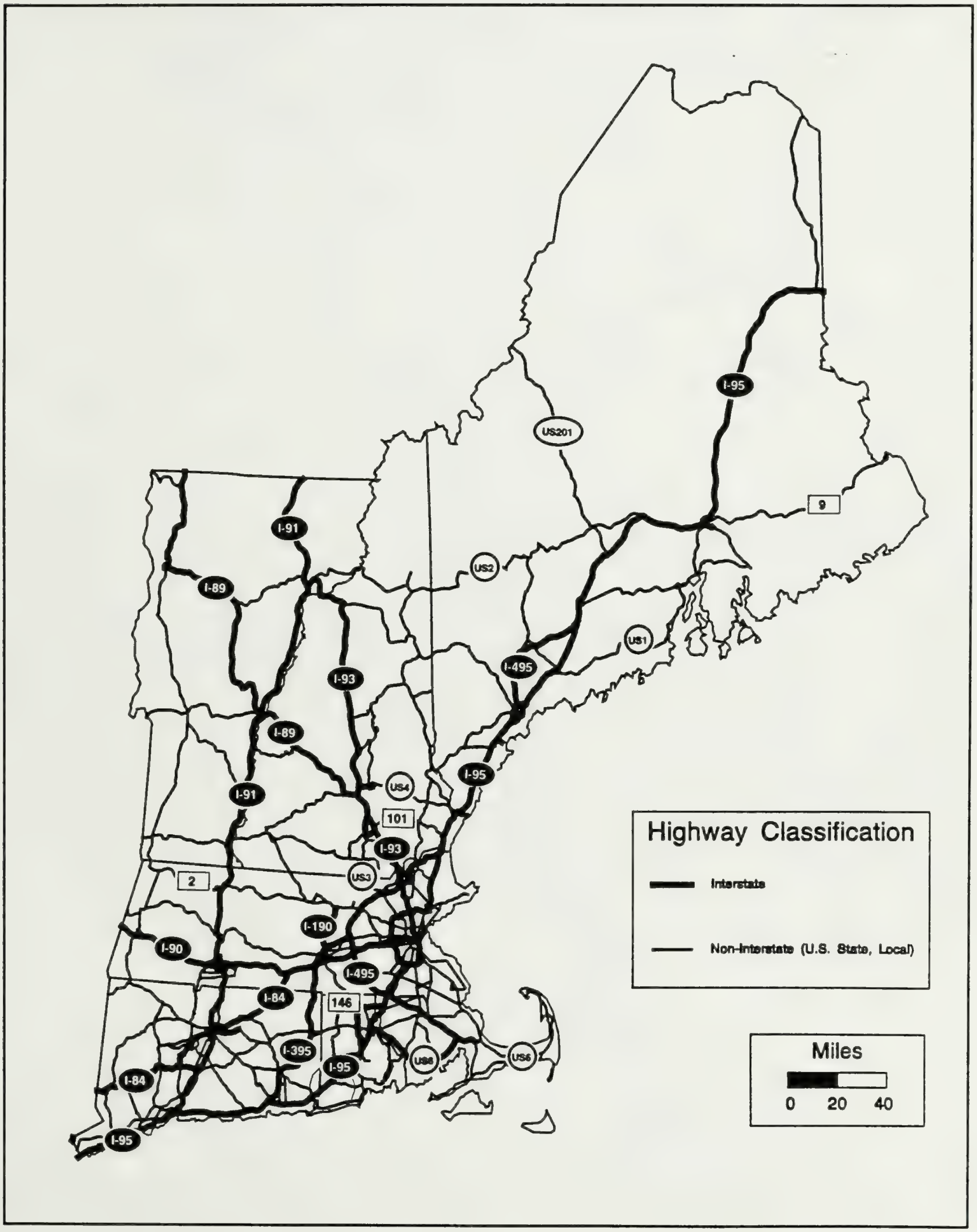


Figure 2.2 Existing Volume to Capacity Ratios – Connecticut and Rhode Island

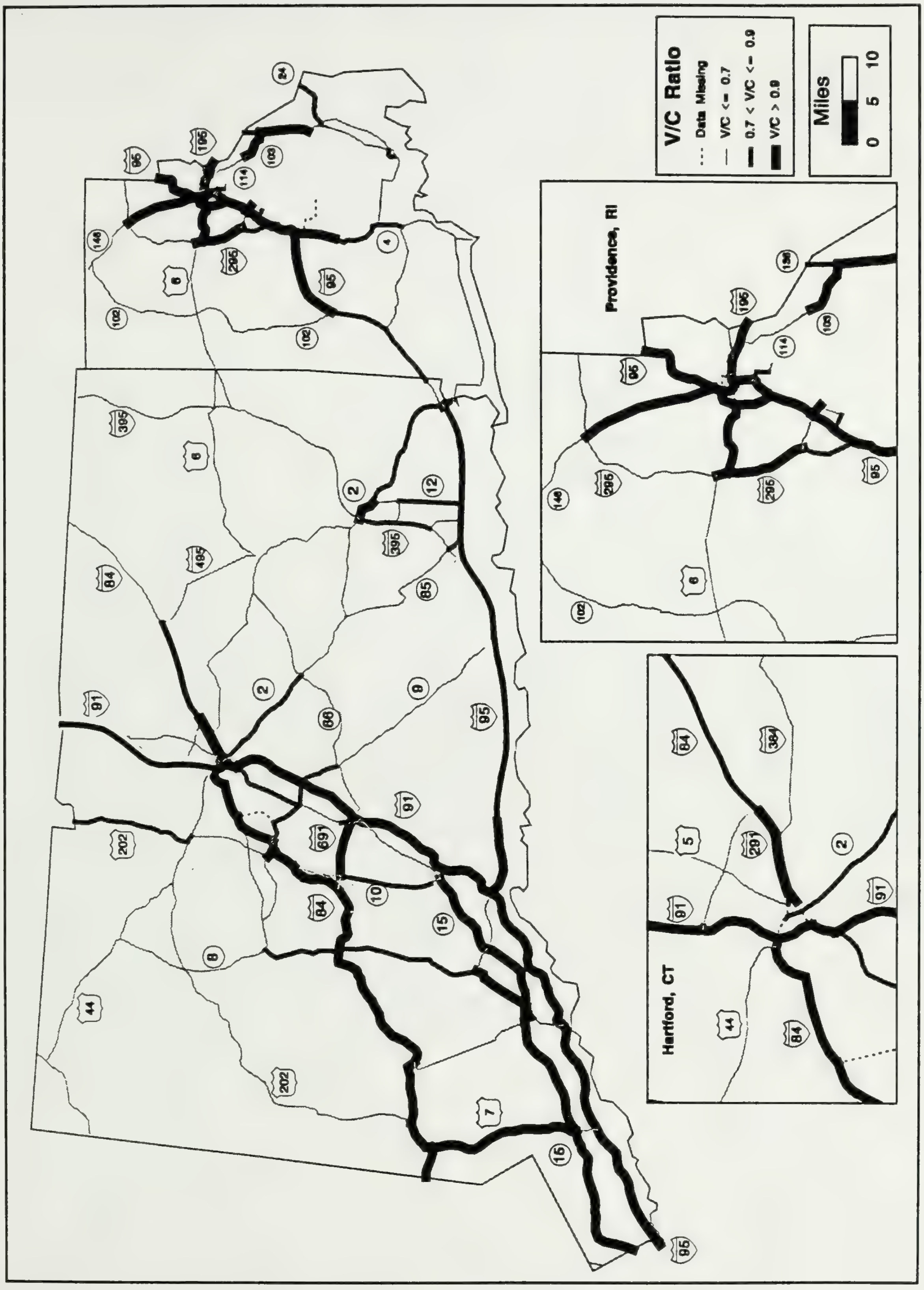


Figure 2.3 Existing Volume to Capacity Ratios – Maine

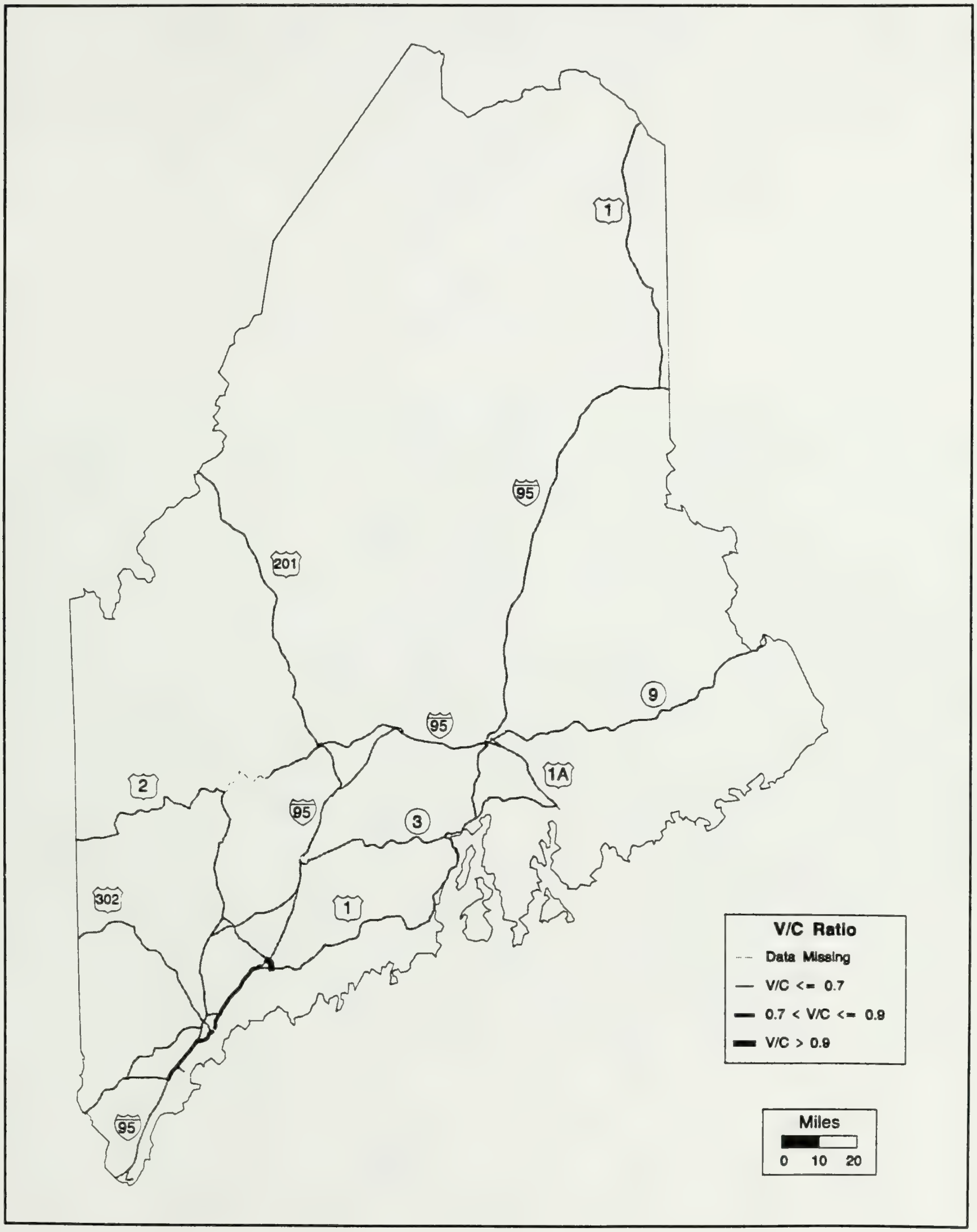


Figure 2.4 Existing Volume to Capacity Ratios – New Hampshire and Vermont

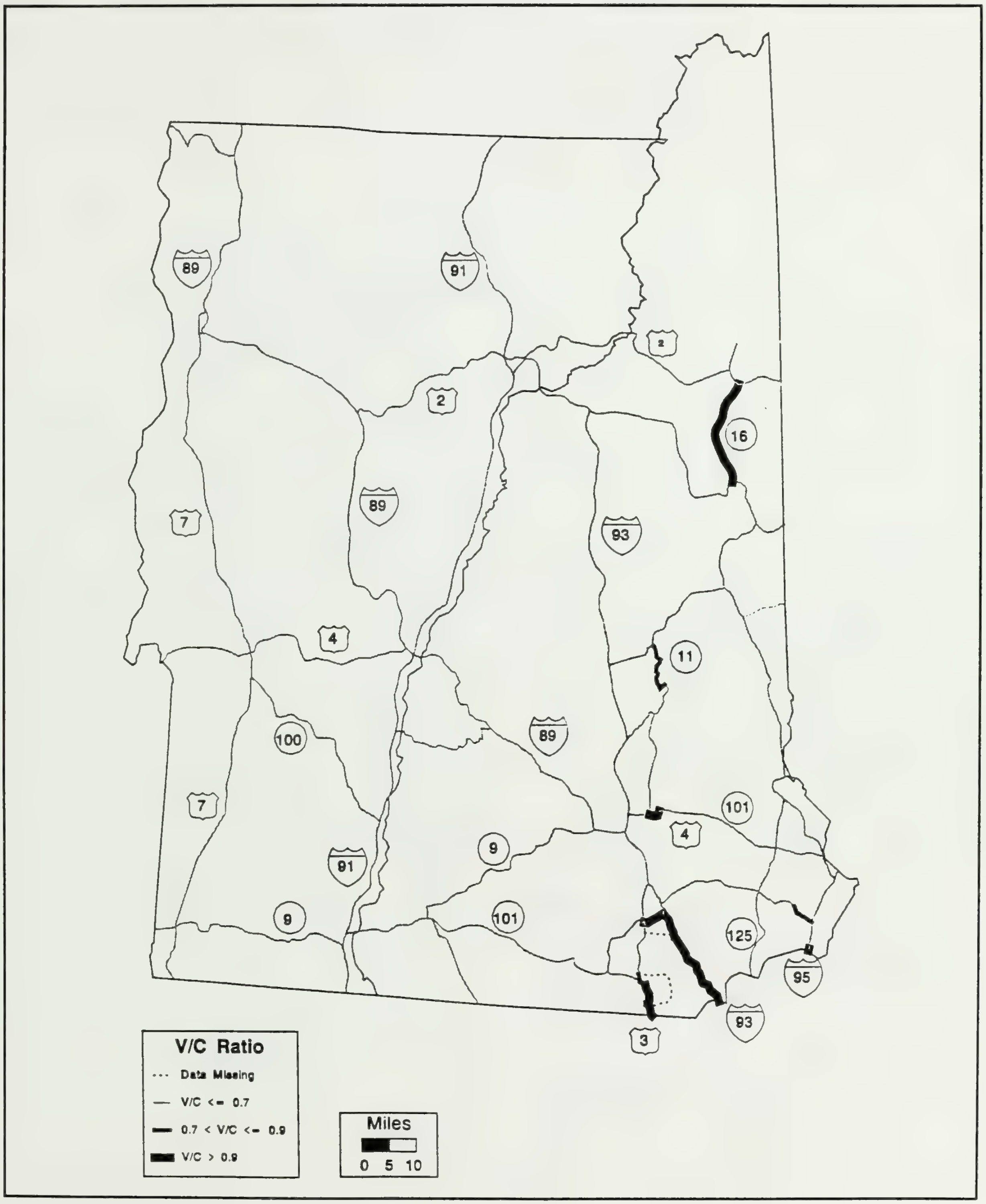


Figure 2.5 Existing Volume to Capacity Ratios – Massachusetts

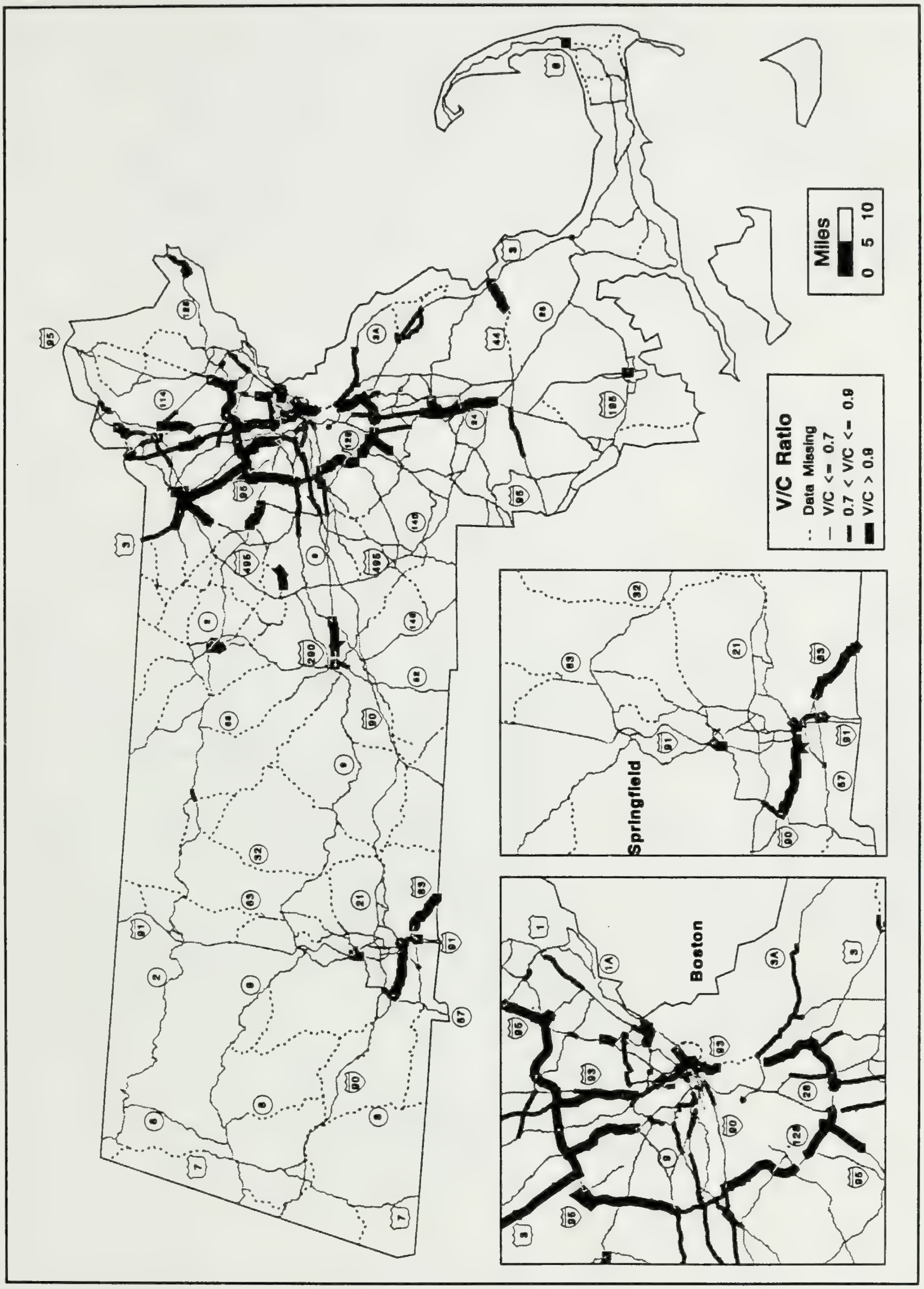


Figure 2.6 Low Growth Forecast Volume to Capacity Ratios – Connecticut and Rhode Island

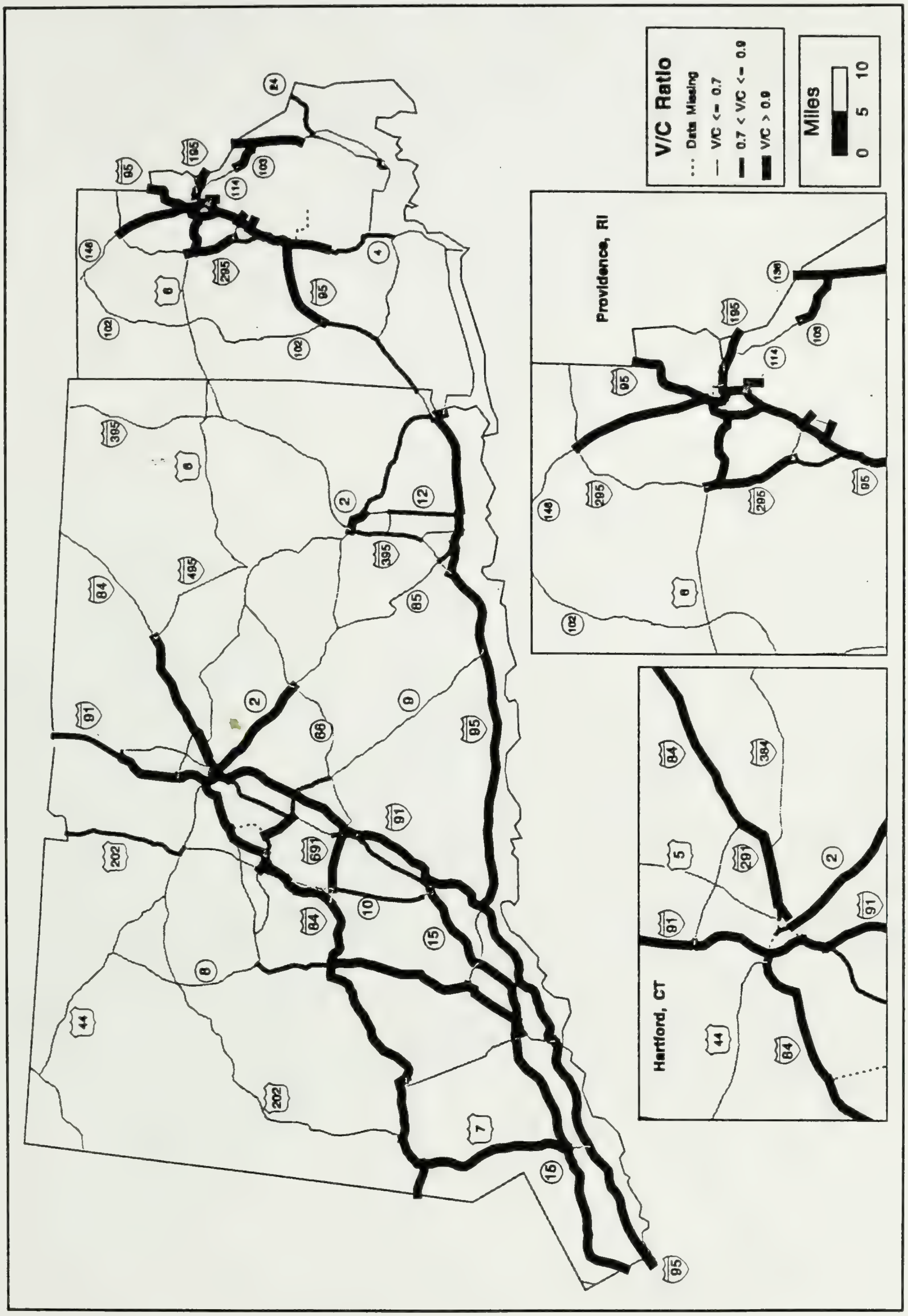


Figure 2.7 Low Growth Forecast Volume to Capacity Ratios – Maine

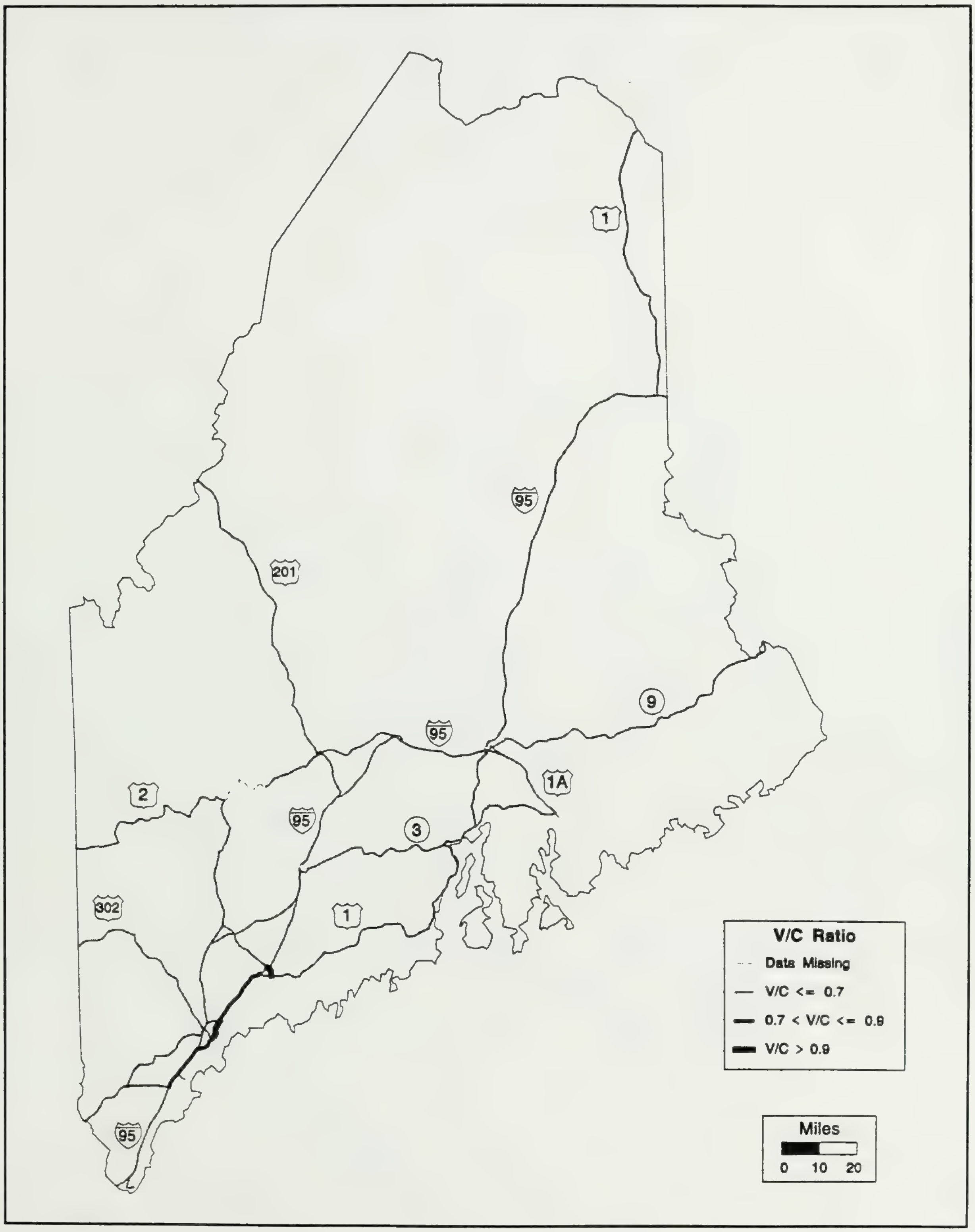


Figure 2.8 Low Growth Forecast Volume to Capacity Ratios – New Hampshire and Vermont

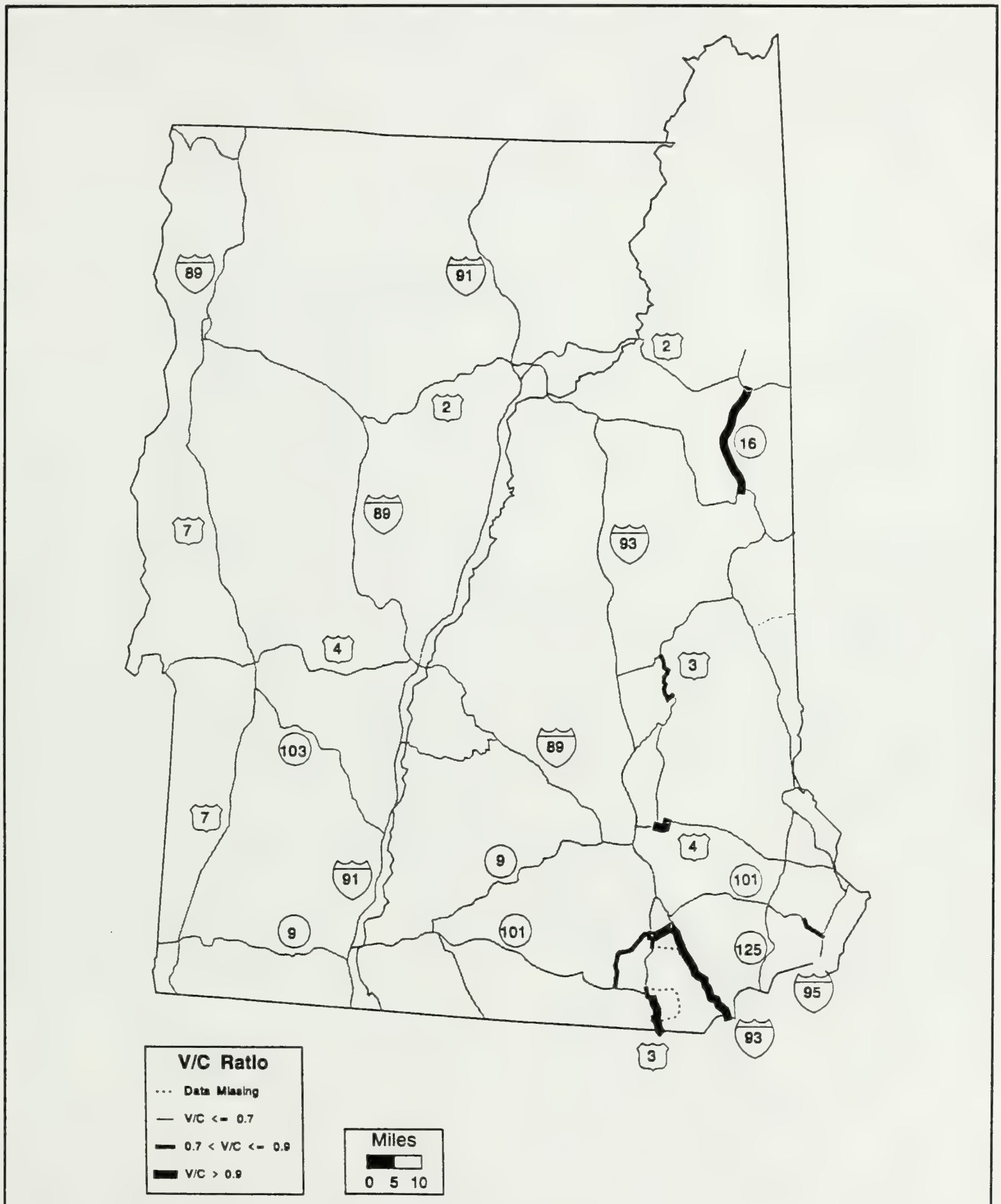


Figure 2.9 Low Growth Forecast Volume to Capacity Ratios – Massachusetts

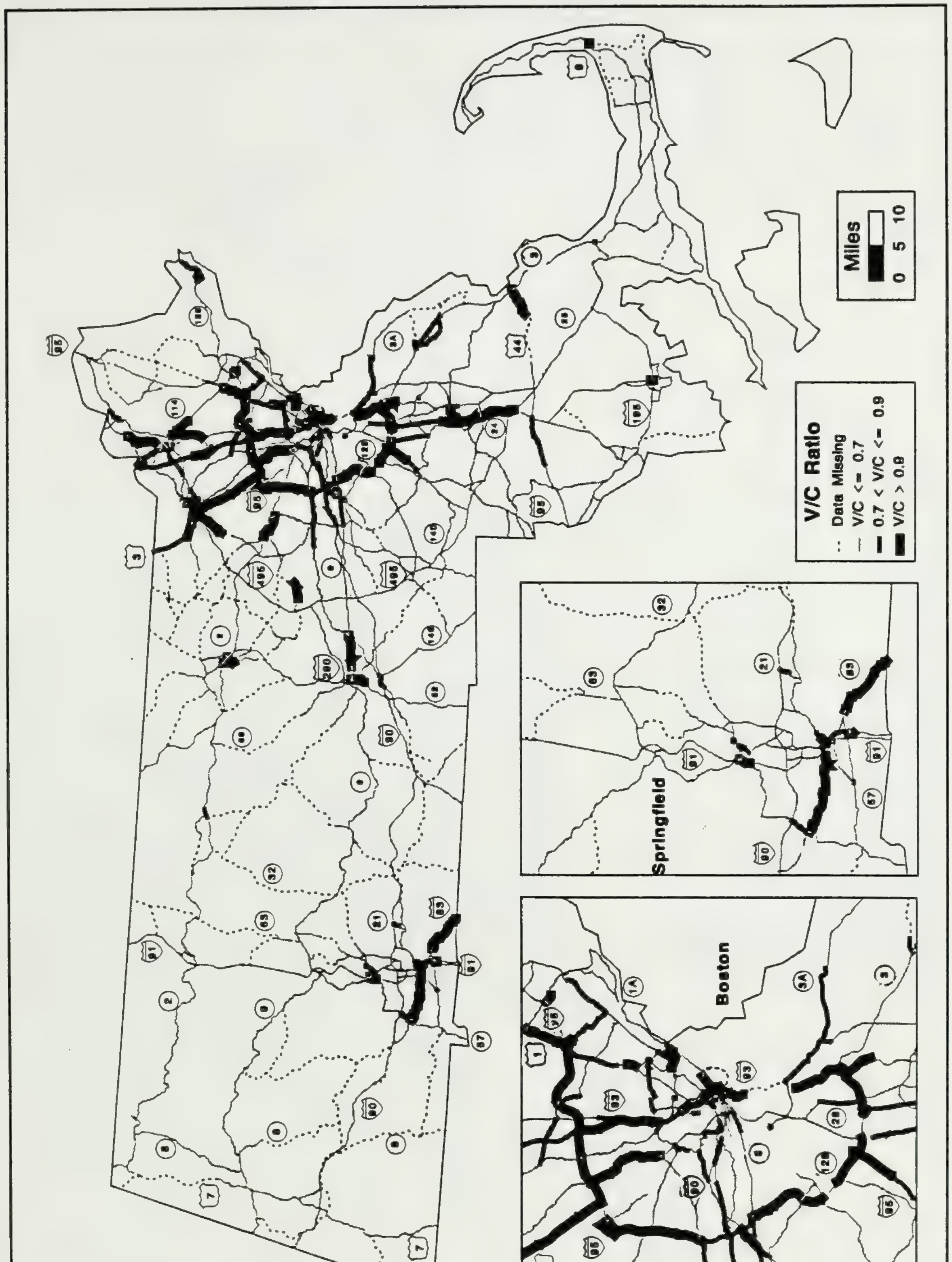


Figure 2.10 High Growth Forecast Volume to Capacity Ratios – Connecticut and Rhode Island

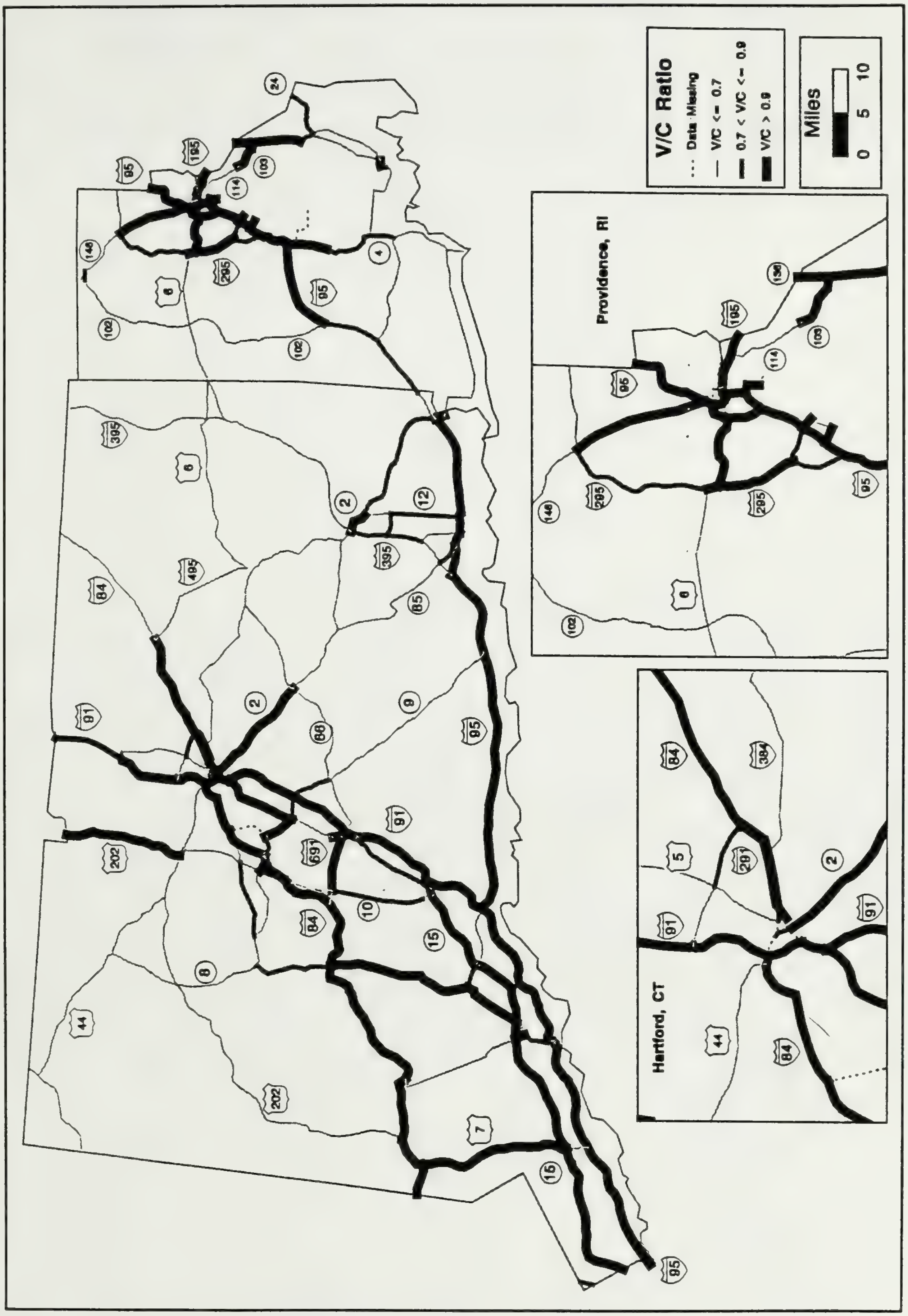


Figure 2.11 High Growth Forecast Volume to Capacity Ratios – Maine

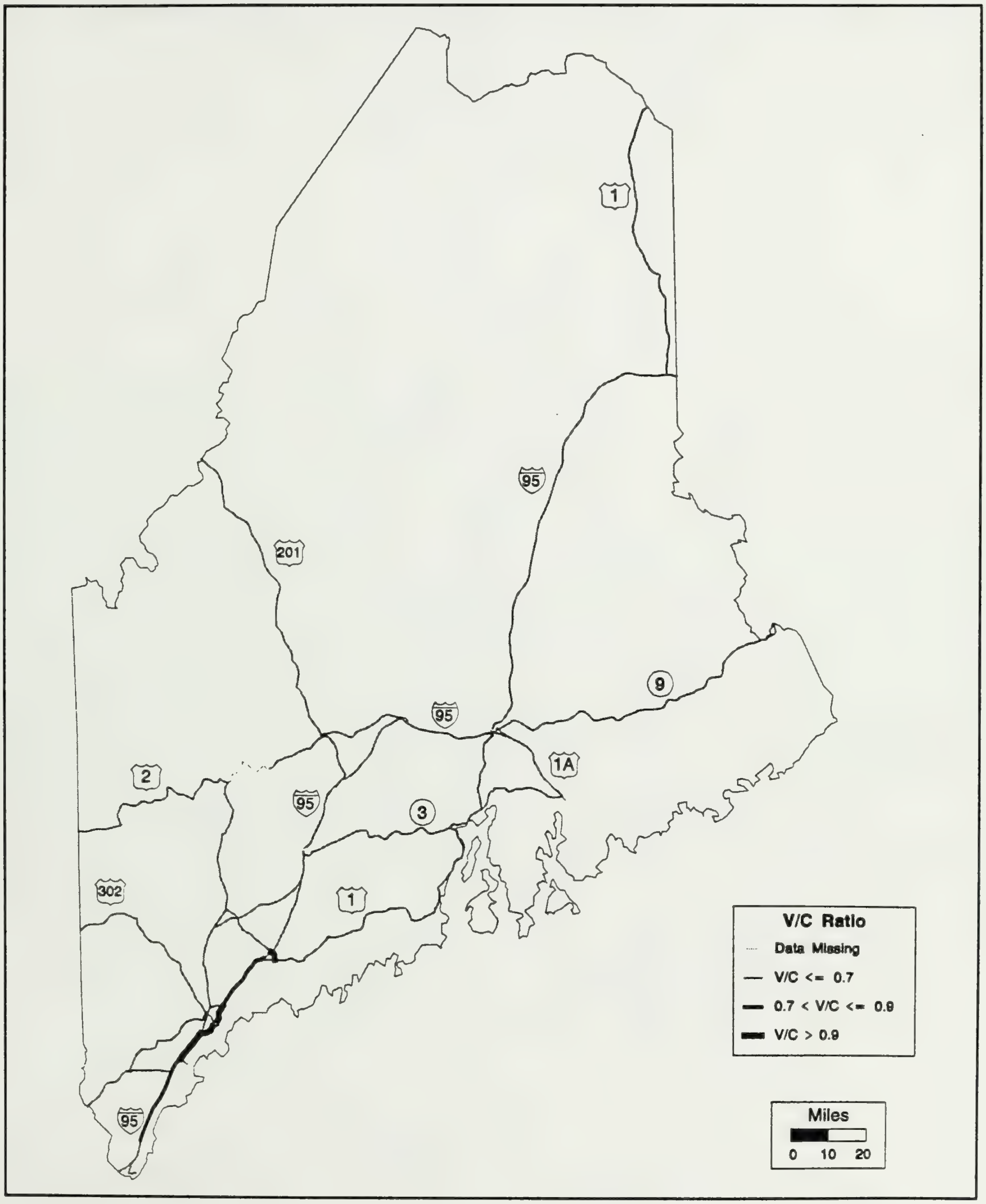


Figure 2.12 High Growth Forecast Volume to Capacity Ratios – New Hampshire and Vermont

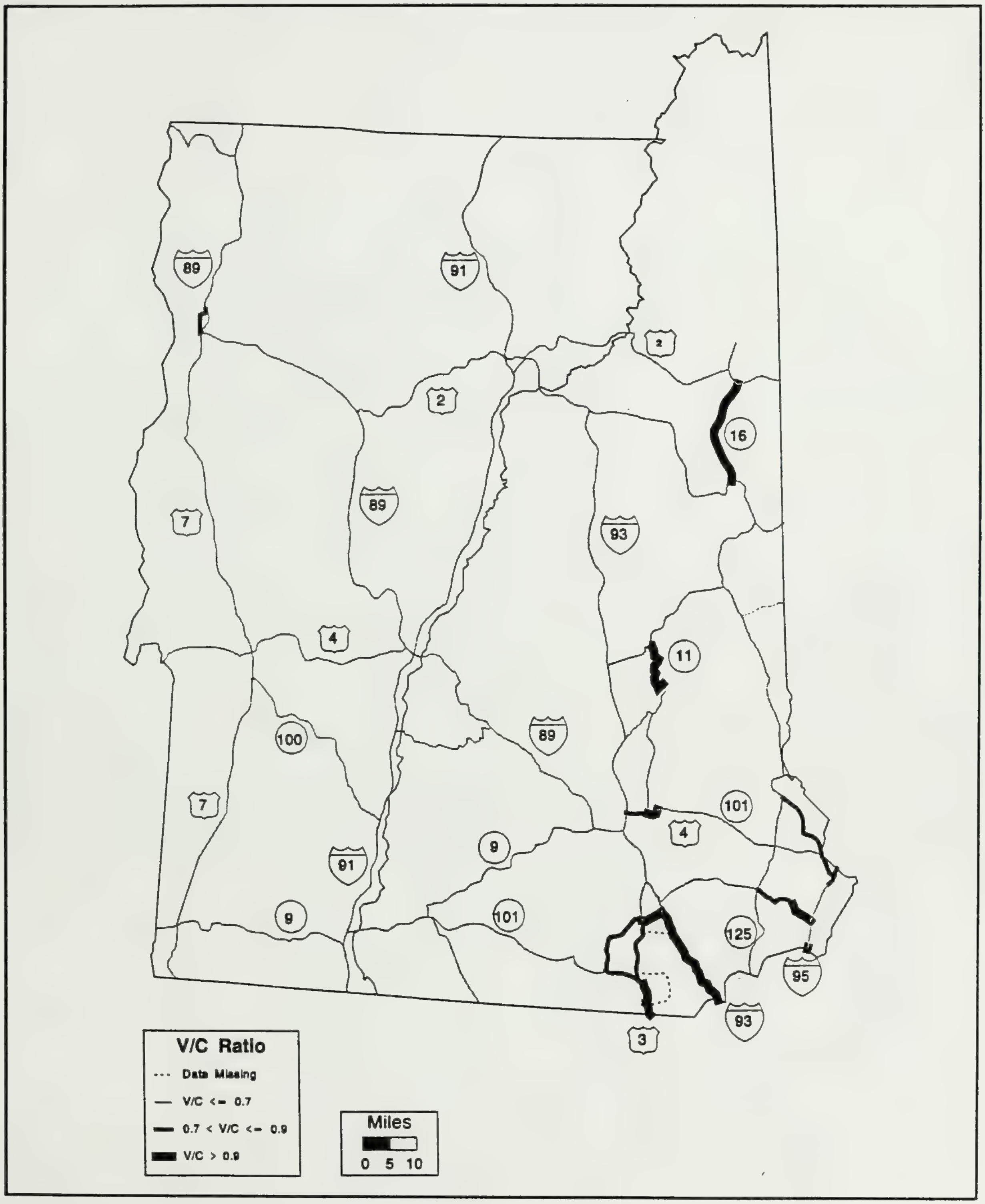
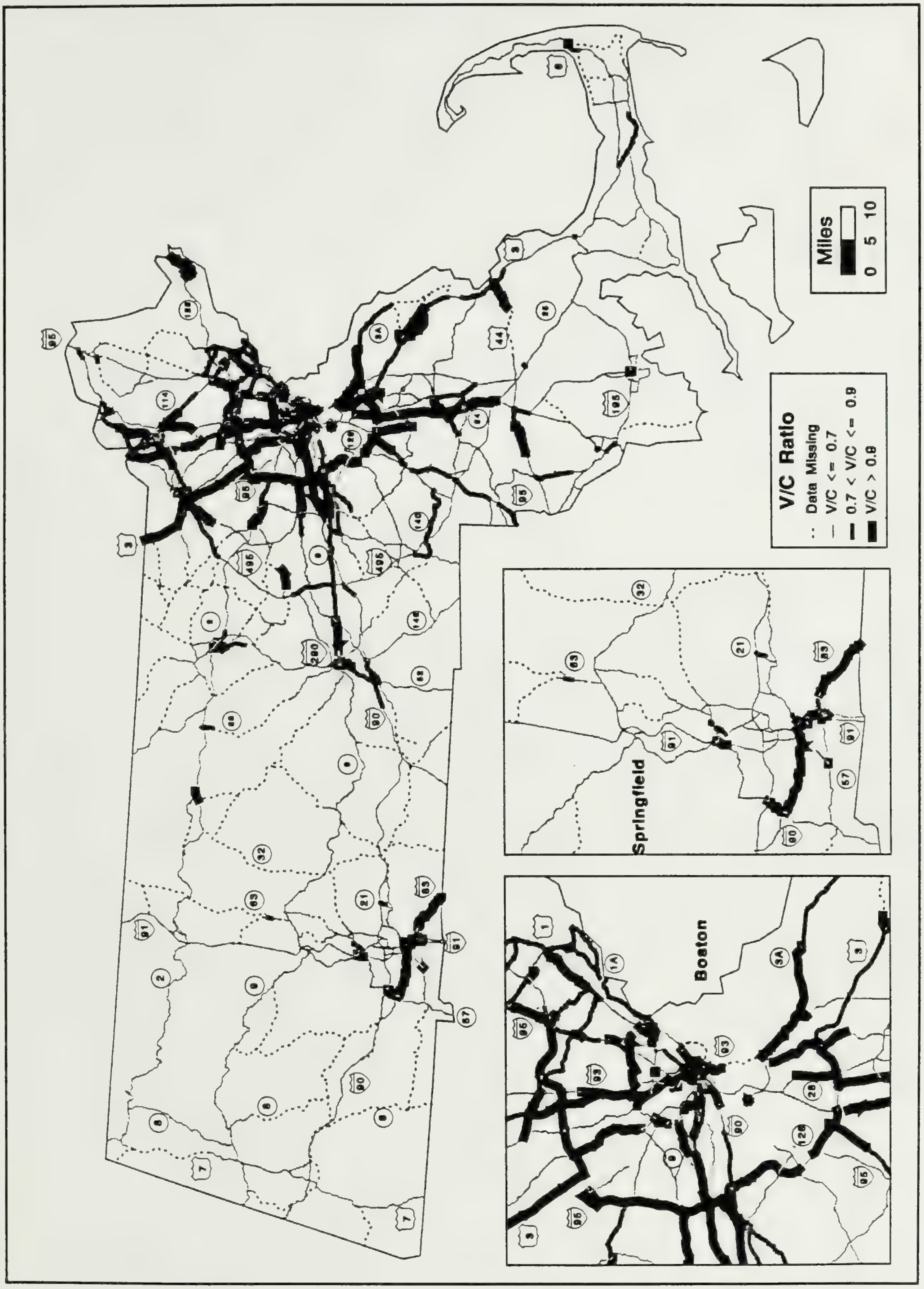


Figure 2.13 High Growth Forecast Volume to Capacity Ratios – Massachusetts



3.0 Railroads

3.0 Railroads

3.1 Introduction

The material presented herein as related to rail passenger, rail freight and associated intermodal activities is based largely on published data and research. As was the case for the Inventory Report, passenger data was gleaned primarily from the sponsoring state and federal entities. The source material is typically a "planning document" and as such most of the forecasts reflect the use of 2010 as a planning or horizon year. This is also reflected in the tabulations presented in this report. The source documents also reflect various nuances in terminology and in the manner by which ridership data is presented (i.e., one-way, round-trip, directional boardings, etc.) Although every effort was made to "normalize" these factors, the various tabulations should be read carefully.

Forecast data for rail freight traffic was not widely available for a 10 or 15-year horizon. Therefore, growth factors which were identified from national and regional trends were applied to existing rail freight flow and volume statistics. While this cannot be expected to forecast future movements on specific branch and trunk lines, this approach does permit an overall evaluation of regional and interstate rail freight movements. A combined and detailed analysis of freight shipments (by routing and commodity type) for rail, truck and ship would appear to be a necessary adjunct for the planning of port and intermodal facilities in the region. Forecasts are provided for the year 2000.

3.2 Passenger Operations

3.2.1 Amtrak

Northeast Corridor

Amtrak's service and ridership along the "Shore Line" route between New Haven and Boston is forecast to undergo major growth as a result of the Northeast Corridor Improvement Project (NECIP) which will transform the New Haven-Boston segment into a high speed electrified rail corridor. Ridership projections for the NECIP Environmental Impact Statement/Report (EIS/R) were prepared by the Federal Railroad Administration (FRA) in consultation with Amtrak. These forecasts were prepared for the year 2010 for the proposed electrification project and for the 2010 baseline (or "no-build) situation. This report will use these two scenarios to represent the upper and lower bounds for Amtrak's Northeast Corridor (NEC) ridership forecasts.

Without electrification and the associated high speed elements, no improvement in intercity rail travel time is expected. However, total intercity travel in the Northeast Corridor (between four major city pairs; Boston-New York, Providence-New York, Boston-New Haven and Providence-New Haven) is expected to increase by approximately 3.7 million (21 percent) in the period between 1988 and 2010.

This increase represents a change of less than one percent annually over the 22-year period and is deemed to be the result of normal growth in corridor travel. Boston-Providence travel is not included in these estimates as the metropolitan areas of these cities nearly overlap and the majority of the travel between these cities is commuter-oriented. A slight modal shift is expected to occur from air and automobile to intercity rail, as a result of the increasing congestion experienced on highways and at airports. This shift would not be significant.

With high speed improvements including electrification and new rolling stock, Amtrak's express service travel time between Boston South Station and Penn Station New York would decrease to under three hours as compared to four hours in the no-build alternative. Express service frequency would increase from two trains daily in each direction to six in each direction. Implementation of the electrification project is not anticipated to have any effect on total intercity travel in the NEC. Shifts could be made, however, from air to rail modes. Total Amtrak ridership in this market is anticipated to nearly double, from almost 1.9 million to over 3.6 million annually. In the two major air corridor markets, Boston-New York and Providence-New York, Amtrak ridership is forecast to grow by over 100 percent and 80 percent respectively. In addition to high speed express service, Amtrak will continue to operate conventional intercity service between Boston and New York. Ridership forecasts for the alternatives are summarized in Table 3.1 and Table 3.2.

Inland and Long-Haul Services

Amtrak's conventional services which operate off of the Northeast Corridor in New England, including the *Montrealer* and the *Lake Shore Limited*, have not received the detailed analysis which has been afforded the NEC services. Most of these off-Corridor trains operate on trackage owned by freight railroads as was detailed in the NETI Inventory Report. Amtrak operates on freight-owned railroads under a 25-year contractual agreement which took effect in 1971 and which will expire in 1996. When this contract is renegotiated it is likely that terms and conditions requested by freight railroads (especially as concerns liability insurance) will result in the restructuring of Amtrak's long-haul routes. Since Amtrak's *Montrealer* and *Lake Shore Limited*/Inland Route services operate over freight railroad trackage in New England (Conrail and Central Vermont) any forecast of station locations and ridership is best viewed as being somewhat tenuous. For the purposes of this report, 1992 station volumes on these routes have been factored to reflect annual growth rates of 0.5 percent and one percent to the year 2010 (see Table 3.3). As concerns the *Montrealer* it should be noted that the State of Vermont has proposed a connecting rail service between Rutland and Bellows Falls and additional station stops on the existing *Montrealer* route. Ridership estimates (forecast year not specified) for these new Amtrak stops (Table 3.4) were presented in the "Vermont Rail Feasibility Study." Vermont is also considering Rutland-Whitehall connection to New York City.

3.2.2 Connecticut

Service between New Haven and New York City's Grand Central Terminal is operated by the Metro-North Commuter Railroad on behalf of the State of Connecticut and is projected to grow at a modest rate of 24 percent over an almost 20-year period (slightly more than one percent annually). A breakdown of ridership forecasts by line and by station is given in Table 3.5. This assumes a continued aggressive program to increase the supply of park-and-ride spaces.

The State of Connecticut has commenced work on expanding storage and maintenance facilities on the New Haven Line to accommodate an expanding fleet of multiple unit cars and locomotive hauled coaches. A detailed study of maintenance facility requirements on the New Haven Line was conducted between 1985-1987. The ensuing report "The New Haven Line, Maintenance Facilities Project, Tasks 1-4" has served as the basis for implementing the ongoing maintenance facility expansion program.

Service between New Haven and Old Saybrook, identified as Shore Line East, commenced in 1988. Ridership is expected to increase due to regional growth and expanded service to New London by 2010. State of Connecticut ridership forecasts for Shore Line East "A.M. Peak Inbound" in 2010 range from 1,278 to 2,166. The lower figure reflects a six percent rail "capture rate" for work trips while the higher figure reflects a 10 percent "capture rate." These ridership forecasts represent a net growth factor of 124 percent and 210 percent, respectively, over 1992 ridership levels.

3.2.3 Rhode Island

Existing commuter rail service ridership from Providence to Boston on the Massachusetts Bay Transportation Authority's (MBTA) Attleboro Line is included in the subsequent MBTA discussion. Commuter service to Providence was inaugurated in 1988 after a nine-year hiatus, in part to alleviate overcrowding at the Attleboro station. Ridership peaked in early 1990 with approximately 550 daily round trips. (This vastly exceeded original estimates of 200 passengers per day). In August 1990, the MBTA opened a new station in nearby South Attleboro which resulted in a decline in ridership of about 20 percent at Providence. (Current 1994 daily ridership averages 475.) The loss of ridership is believed to be due to the availability of inexpensive parking at South Attleboro with convenient access to Interstate 95. Rhode Island DOT is conducting preliminary surveys to determine the potential for bus service to the parking lots at Attleboro and South Attleboro. Providence ridership growth is also restrained by the lack of midday and evening service. Only five daily round trips (peak period) are operated from Providence. By contrast, South Attleboro is served by 16 round trips. Rhode Island DOT officials expect to increase service levels when a new service contract is negotiated with the MBTA, to take effect in February 1995. Presumably, this will result in a better balancing of ridership with respect to the South Attleboro and Providence stations.

The Rhode Island DOT is also exploring the potential of phasing in commuter rail service to the southern portion of the state. The most likely first stop would be a station in Warwick (Hillsgrove) providing connections to T.F. Green State Airport.

3.2.4 Massachusetts

Ridership on the commuter rail system managed by the Massachusetts Bay Transportation Authority has grown steadily over the past decade. The recent introduction of weekend service on the "south side" commuter rail lines and special events such as the 1992 "Tall Ships" festivities in Boston have served to augment the growth in ridership.

In 1990 the MBTA prepared an inventory and analysis of its commuter rail operations (existing and projected through to the year 2010) in order to evaluate the system capacity requirements as defined by cars, locomotives, terminal configuration, storage yards and siding locations. The updated report also focused on the interface between MBTA Commuter Rail operations and proposed Amtrak high speed rail service in the MBTA – owned territory between South Station and Attleboro. Ridership forecasts were prepared for the years 2000 and 2010 using, in part, data and forecasts generated by the Central Transportation Planning Staff (CTPS). As presented in the Support Facilities Report, the ridership forecasts are also offered herewith (Tables 3.6 and 3.7) as an estimate of future ridership growth within an upper and lower range. These forecasts represent a more than doubling of the 31,600 daily round trips today, and assume all planned extensions in addition to an aggressive underlying growth rate, but do not assume the North Station-South Station rail connector.

The Support Facilities Report reached the conclusion that "existing and committed [1990] track and support facilities ... can sustain the projected (to year 2010) commuter and intercity rail services." Station parking facilities were not examined in the report. The MBTA's 1992 "Ridership and Service Statistics" report identifies several stations as presently having passenger parking usage in the range of 85 percent to 100 percent of capacity (Table 3.8). Parking constraints could serve to limit long-term ridership growth absent the development of expanded facilities.

3.2.5 Maine

Service between Boston and Portland, to be operated by Amtrak, may begin by the end of 1994. The Environmental Impact Statement prepared for the project forecast ridership for the year 2010 as shown in Table 3.9. The "integrated rail-bus" ridership is the greatest of all alternatives considered, and is presented in this report as the upper bound forecast for the 2010 Boston-Portland rail ridership. The "rail only" alternative is presented as the lower bound.

Based on the ridership data generated for the Environmental Impact Statement, potential patrons making other than business and commuter trips will comprise the largest user group of this service. The forecast split between the three types of ridership is 65 percent

"other" (i.e., personal business, recreational, tourist), 21 percent "business" and 14 percent "commuter."

The long-term status of the VIA Rail "Atlantic" service operating between Halifax and Montreal through upstate Maine is extremely dubious, given the impending abandonment of the route by its owner, CP Rail. The "Atlantic" may survive, albeit on a route using remaining Canadian rail lines which do not pass through Maine. For these reason, no attempt has been made to forecast ridership on the "Atlantic" with respect to the State of Maine.

3.2.6 New Hampshire

The NETI Inventory Report identified the extension of MBTA Commuter Rail service from Massachusetts to Nashua and Plaistow as potential future services. Ridership estimates are not available. A study is now underway to identify the potential market for rail passenger service between Nashua and Manchester.

3.2.7 Vermont

The NETI Inventory Report identified commuter rail and tourist rail services as two pending projects for the state. The 1993 "Vermont Rail Feasibility Study" presented an analysis of commuter rail corridors between Barre-Burlington, Rutland-Burlington and St. Albans-Burlington. The Feasibility Study commented that the "range of ridership forecasts developed for each of the three commuter rail service corridors demonstrates the limited demand for commuter rail service." This is due to the relatively low population and employment densities in the corridor. Forecasts are shown in Table 3.10.

The range of ridership forecasts reflects a 10 percent capture rate for the total commuter market, which is not atypical for a commuter rail service. The possibility of augmenting the ridership with reverse-direction commuters was examined for the Barre-Burlington corridor. Based on the size of the reverse direction commuter market, the rail service would likely obtain only 37 to 59 one way reverse commuter trips daily.

Vermont proposes to operate this service at a higher level than recommended in this study, seeking to attract (in addition to commuters) tourists, transportation disadvantaged, and resident discretionary travel. Implementation is scheduled for late 1995.

3.3 Freight Operations

As was discussed in the NETI Inventory Report, the availability and comprehensiveness of rail freight data varies considerably among carriers and states. In order to provide a

uniform baseline of railroad freight traffic in New England, the report "Railroad Traffic in the Untied States – 1992" published by ALK Associates was utilized. Based on the Interstate Commerce Commission's Carload Waybill Sample, this document provides estimates of tonnage originating and terminating in each state, by commodity group, and the rail freight traffic flowing between each state and its neighboring states and provinces by commodity and by car type. Two limitations of the sample need to be remembered; namely, most small railroads do not report a sample of their traffic to the ICC, and traffic terminating in Canada is not sampled. Traffic originating in Canada is included.

According to the ICC sample for 1992, the six New England states generated 27.4 million tons of rail freight traffic in 1992. Reflecting the region's status as a consumer of raw materials and finished products, terminating tonnage accounted for 72 percent of the New England rail freight volume. Only 28 percent of the tonnage is shown as originating within New England. It should be noted that intrastate traffic is counted as both originating and terminating within the same state. Also, the tonnage values are "net" so that the movement of empty rail cars is not included. A complete tabulation of volumes by state and commodity is presented in Table 3.11. The associated volumes of interstate rail movements are depicted in Figure 3.1. It can be observed that the New York-Massachusetts corridor constitutes the dominant route for freight rail shipments into and out of the New England region. Raw materials and bulk commodities make up most of the rail traffic. Intermodal trailer and container traffic is covered under the category "All Other" and is presently focused on the Massachusetts-New York rail corridor.

Some singular rail traffic flows are evidenced in the 1992 data including: the movement of unit coal trains to Bow, New Hampshire; the movement of fuel oil from Searsport to paper mills located within Maine; the movement of crushed stone from the Branford and Reed's Gap quarries in Connecticut; the heavy movement of inbound petroleum products into Vermont from New York; and shipment of automobiles from Quonset Point/Davisville. Originating and terminating traffic is well balanced in Maine, reflecting the dominance of intrastate shipment of timber products from lumbering sites to mills.

The availability of future freight traffic forecasts has proven to be more elusive than existing traffic data. The 1992 Massachusetts Institute of Technology Report entitled "Rail Service in New England" elicited minimal response (from only six out of some 30 railroads) in a survey of rail freight traffic forecasts. In a November 20, 1992 "Wall Street Journal" feature article on the "aggressive growth attitude" of Conrail, a five-year system-wide plan was presented as follows:

Business Group	**Projected Compounded Annual Growth (1991-1996)**
Coal	8.7%
Intermodal	6.1%
Chemicals	3.0%
Automotive	4.6%
Food Products	3.7%
Metals	4.9%
Solid Waste	52.0%
Average Total	**5.5%**

Conrail operates an extensive system in the eastern U.S., and thus these projections are not necessarily applicable to New England, but they do indicate that "Intermodal" and "Solid Waste" should be viewed as growth areas for rail freight.

For the purposes of developing forecasts at this stage of the NETI project a low growth factor of one percent and a high growth factor of two percent were applied to all of the commodity categories except "All Other" and "Waste and Scrap Materials." The one percent to two percent annual growth range is similar to that reflected in recent Association of American Railroad Statistics and represents an assumed growth in regional construction and business activities which generate demand for building supplies, paper, petroleum, etc.

Two categories which are deemed to be areas of exceptional growth opportunities are Intermodal (covered under the category "All Other") and Waste Materials. Nationally, intermodal traffic has exhibited a sustained annual growth rate of approximately seven percent. For 1993, the Association of American Railroads (AAR) data identify a growth in intermodal traffic of 7.9 percent over 1992. It should be recognized that much of this growth has been fueled by the diversion of truck shipments to rail and by the creation of rail landbridge operations. However, much of the landbridge generated growth has already occurred, and it should be recognized that traffic shifts to Southwest Asia could actually lead to a diversion of some West Coast cargo to a Suez Canal – East Coast routing. Continued intermodal growth will likely come from railroad partnerships with national trucking companies such as Schneider National and J.B. Hunt. An as-yet untapped rail intermodal traffic base is the movement of perishable foods from West Coast growers to Midwest and East Coast Markets. Perishables foods contain mostly water and load heavy, and this has prevented their movement in large volume intermodal rail cars. However, newer double stack cars with increased loading capacities will bring the economics of double stack trains to long-haul perishable transportation. Recognizing that New England also has significant opportunities for expanding its intermodal port facilities, the seven percent growth factor has been carried forward to the year 2000 as a high growth forecast. A low growth intermodal factor of five percent annually can be construed to represent a continuation of the regional status-quo (absent any significant New England port developments and/or route clearance improvements) combined with a maturing in the growth of intermodal service nationally.

The Commonwealth of Massachusetts has identified a major program of route and clearance improvements to facilitate access to Boston area ports and terminals for intermodal rail service. Estimates of anticipated increases in intermodal rail volumes attributable to these improvements were not available. In Rhode Island, the Rhode Island Port Authority has developed a reuse plan for the former Davisville military complex. An environmental study for alternate track configuration and improved vertical clearance is also underway. A Rhode Island DOT study of expanded freight service assumed that 20 percent of the truck shipments which originate or terminate in Rhode Island (and which travel more than 500 miles) could be diverted to a Davisville rail intermodal facility. However, no identification is given of the commodities being shipped by truck which would be diverted, nor are the truck shipment routes identified. Thus, it is not possible to fully analyze the impact of these assumptions on the New England rail network.

A comprehensive regional analysis of freight movements and an evaluation of potential opportunities for intermodal growth are needed and would require more detailed commodity/market data than evidenced in the projects mentioned above.

A second area of opportunity is the movement of solid waste to landfills or other disposal sites. With the closure of local landfills, there are growing opportunities for longer distance (i.e., railroad competitive) movements to reclamation or disposal sites. On Cape Cod, Bay Colony railroad was the first rail carrier in the country to operate a large volume dedicated movement of municipal solid waste (MSW). Presently, more than 50,000 tons of MSW are moved annually from points on Cape Cod to a power plant in Eastern Massachusetts that burns the trash as fuel. Conrail participates in the movement of pelletized sewage sludge from the Massachusetts Water Resources Authority facilities in Quincy to Virginia (via CSX), with approximately 200 tons being shipped daily in specialized container cars. On a very localized scale, the Connecticut Central Railroad moves sewage between treatment facilities in Middletown and Cromwell, Connecticut.

Much has been written about the amount of waste material generated in the United States. A study prepared in 1988 by the Environmental Protection Agency estimated that a total of 12 billion tons of waste material are generated annually in the U.S. ("Progressive Railroading," January 1993). Although the categorizations and compositions used in the EPA analysis have been subject to dispute, the order of magnitude of this potential market represents a tremendous growth opportunity for rail carriers. Of the total waste generated annually in the U.S., less than three million tons presently moves by rail. In New England, the waste paper industry would also appear to be a major component of this market.

For this commodity group forecast, a high growth factor of 10 percent annually and a low growth factor of five percent have been assumed. This market is clearly in an embryonic stage in terms of railroad market share potential.

The present and forecast distribution of commodities by tonnage are presented for each state, and for New England in total, in Figures 3.2 through 3.8. The traffic flows between states are presented schematically in Figures 3.9 and 3.10. The traffic flows illustrate the continued dominance of the New York gateway to the New England region. Connections to Quebec and New Brunswick will continue to play a role although it should be recognized that these Canadian connections will be subject to significant operational changes as the ongoing CN and CP route contraction and restructuring evolve.

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Tables

Table 3.1 Amtrak Projected NEC Annual Intercity Travel 2010

Service	No-Build	Electrification
High Speed Rail Business and Non Business		
Boston-New York	351,640	1,146,791
Providence-New York	164,549	376,126
Boston-New Haven	75,026	130,962
Providence-New Haven	18,158	27,396
Subtotal	609,373	1,681,275
Conventional Rail/Business and Non Business		
Boston-New York	791,724	1,355,164
Providence-New York	264,866	410,064
Boston-New Haven	172,843	150,762
Providence-New Haven	32,825	29,699
Subtotal	1,262,258	1,945,659
Total Ridership, All Services	**1,871,631**	**3,626,934**

Source: Federal Railroad Administration, Volpe National Transportation Systems Center – 1993.

Table 3.2 NEC Travel – Modal Split by Rail Alternatives

Mode	Existing		No-Build 2010		Electrification 2010	
	Ridership (000's)	Percent	Ridership (000's)	Percent	Ridership (000's)	Percent
Auto	13,418	74.5	15,919	73.8	15,595	72.3
Air	3,529	19.6	3,781	17.5	2,351	10.9
Rail	1,053	5.9	1,871	8.7	3,627	16.8

Source: Federal Railroad Administration – 1993.

Table 3.3 Amtrak New England Inland/Long-Haul Station Annual Ridership

Station	Total On & Off	
	2010 (Low)	2010 (High)
Amherst, MA	3,783	4,165
Bellows Falls, VT	2,636	2,902
Berlin, CT	39,918	43,946
Brattleboro, VT	6,586	7,250
Burlington – Essex Junction, VT	19,509	21,478
Claremont, NH	2,324	2,558
Framingham, MA	9,244	10,177
Hartford, CT	203,917	224,496
Meriden, CT	40,274	44,339
Montpelier, VT	12,225	13,495
Saint Albans, VT	5,028	5,536
Springfield, MA	167,367	184,258
Wallingford, CT	17,656	19,438
Waterbury – Stowe, VT	5,766	6,348
White River Junction, VT	21,941	24,155
Willimantic, CT	2,324	2,558
Windsor Locks, CT	25,356	27,914
Windsor, CT	4,199	4,622
Worcester, MA	43,745	48,160

Source: National Railroad Passenger Corporation (base data).

Table 3.4 Amtrak – New Vermont Stops – Annual Ridership

Town	Total On & Off
Bolton	4,821
Brattleboro	7,500
Burlington	26,453
Ludlow	5,155
Middlebury	6,418
Randolph	5,698
Rutland	9,498

Source: Vermont Rail Feasibility Study.

Table 3.5 New Haven Line Projected Parking Needs – 2000, 2010

Based on Weekday Boardings Prior to 1:00 PM

Main Line Stations	1991 Factored Ridership	2000 Projected Ridership	2010 Projected Ridership	Current Parking Spaces	Current Parking Usage	Current Spaces Available	Current % Available	On going Parking Expansions	Total Parking As of '93	2000 Projected Usage	2000 Shortage	2000 % Available	2010 Projected Usage	2010 Shortage	2010 % Available	Available Bus Service	1991 People Per Car
New Haven	1,495	1,606	1,846	1,108 ^	888	220	20%			953		14%	1,096		1%	Yes	1.7
Milford	703	786	859	505	426	79	16%			476		6%	521	(16)	-3%	Yes	1.7
Stratford	545	408	455	352	282	70	20%			211		40%	236		33%	Yes	1.9
Bridgeport	478	1,249	1,429	321	240	81	25%			627	(306)	-95%	717	(396)	-123%	Yes	2
Fairfield	2,043	1,855	1,999	1,045	941	104	10%			854		18%	921		12%	Yes	2.2
Southport	166	138	149	98	74	24	24%			62		37%	67		32%	No	2.2
Green's Farms	558	607	648	477	417	60	13%	60	537	454		15%	484		10%	Yes	1.3
Westport	1,786	2,186	2,372	1,279	1,114	165	13%			1,363	(84)	-7%	1,479	(200)	-16%	Yes	1.6
East Norwalk	488	327	362	165	142	23	14%			95		42%	105		36%	Yes	3.4
South Norwalk	770	1,191	1,320	450	352	98	22%			544	(94)	-21%	603	(153)	-34%	Yes	2.2
Rowayton	515	456	505	304	256	48	16%			227		25%	251		17%	Yes	2
Darien	1,409	1,674	1,876	1,085	796	289	27%			946		13%	1,060		2%	Yes	1.8
Noroton Heights	1,224	1,180	1,315	800	708	92	12%			682		15%	760		5%	Yes	1.7
Stamford	2,590	3,204	3,623	1,189 #	997	192	16%			1,233	(44)	-4%	1,395	(206)	-17%	Yes	2.6
Old Greenwich	853	1,107	1,221	582	482	100	17%			625	(43)	-7%	690	(108)	-19%	Yes	1.8
Riverside	881	720	791	334	270	64	19%			221		34%	243		27%	No	3.3
Cos Cob	721	891	982	548	532	16	3%			658	(110)	-20%	725	(177)	-32%	No	1.4
Greenwich	1,835	2,615	2,909	1,275	942	333	26%			1,342	(67)	-5%	1,493	(218)	-17%	Yes	1.9
Waterbury Branch																	
Waterbury	38	45	50	18	18	0	0%	120	138	21		85%	24		83%	Yes	2.1
Naugatuck	22	17	18	50	12	38	76%			9		82%	10		80%	No	1.9
Beacon Falls	10	8	9	70	1	69	99%			1		99%	1		99%	No	10.1
Seymour	13	10	11	60 *	4	56	93%			3		95%	3		95%	Yes	3.3
Ansonia	7	13	15	75	4	71	95%			7		91%	9		88%	Yes	1.8
Derby Shelton	20	23	26	60	12	48	80%			14		77%	16		73%	Yes	1.7
Danbury Branch																	
Danbury	117	230	272	60	40	20	33%	90	150	79		47%	93		38%	Yes	2.9
Bethel	325	201	242	82	77	5	6%	117	199	48		76%	57		71%	Yes	4.2
Redding	124	63	73	45	25	20	44%	40	85	13		85%	15		82%	No	5
Branchville	153	237	275	153	124	29	19%			192	(39)	-25%	223	(70)	-46%	No	1.2
Cannondale	197	152	176	97	87	10	10%	60	157	67		57%	78		50%	No	2.3
Wilton	252	316	369	285	243	42	15%	70	355	304		14%	356	(1)	-0%	Yes	1
Merritt 7	141	61	66	87	87	0	0%			38		56%	41		53%	Yes	1.6
New Canaan Branch																	
New Canaan	1,832	1,251	1,424	957 *	957	0	0%			654		32%	744		22%	No	1.9
Talmadge Hill	406	522	591	317	317	0	0%	100	417	408		2%	461	(44)	-11%	No	1.3
Springdale	501	532	587	201	154	47	23%	40	241	164		32%	180		25%	Yes	3.3
Glenbrook	473	423	465	88	70	18	20%	40	128	63		51%	69		46%	Yes	6.8
Totals:	23,692	26,304	29,330	14,622	12,091	2,531		737		13,658	(787)		15,226	(1,589)			

1992 RIDERSHIP – Ridership from ticket sales distributed to stations in accordance with the 1992 on/off counts.
2000, 2010 RIDERSHIP – AM Peak ridership developed from Series 15 projections. Off-Peak ridership assumes a 2% annual growth factor. Distribution by station same as 1992.

^ Does not include 120 spaces which are leased by CDOT to the Police Dept – does include employee parking as well as Amtrak customers
# Reflects total parking available which includes Amtrak customers
* Reflects total parking available which includes municipal spaces. Total dedicated rail unknown

Table 3.6 MBTA South Side Commuter Rail System Weekday Round Trips

Line	2010 (Low)	2010 (High)
• Framingham Line with service to Worcester	5,250	6,100
• Needham Line	3,000	3,300
• Franklin Line with service to Milford	5,900	6,700
• Attleboro/Providence Line	7,350	8,500
• Stoughton Line with service to East Taunton	4,550	5,100
• Fairmount Line	1,250	1,350
• Old Colony Lines		
Middleborough Line	5,540	6,210
Plymouth Line	3,270	3,660
Greenbush Line	4,250	4,760
South Side Total	**40,360**	**45,680**

Table 3.7 MBTA North Side Commuter Rail System Weekday Round Trips

Line	2010 (Low)	2010 (High)
• Fitchburg/Gardner Line	4,240	5,140
• Lowell Line	5,510	6,770
• Haverhill/Reading Line	4,420	5,390
• Rockport/Ipswich Lines		
Ipswich Line with service to Newburyport	2,810	3,500
Rockport Line	3,080	3,680
North Side Total	**20,060**	**24,480**

Source: MBTA, "Consolidated Report – Support Facilities for MBTA Commuter Rail – Update" July 1990.

Table 3.8 MBTA Commuter Rail Stations – Parking With 1992 Usage at 85 Percent to 100 Percent of Capacity

Line	Station	Parking Supply
• Framingham Line		
	Framingham	121
	West Natick	163
	Natick	71
	Wellesley Square	260
	Wellesley Farms	35
• Needham Line		
	Needham Heights	16
	Needham Center	36
	Needham Junction	170
• Franklin Line		
	Franklin	185
• Attleboro/Providence[1]		
	South Attleboro	532
	Mansfield	445
	Sharon	240
	Route 128	803
• Stoughton Line		
	Canton Junction	520
• Fitchburg/Gardner Line		
	North Leominster	49
	Shirley	25
	Littleton/495	45
	South Acton	280
	Concord	86
	Hastings	61
	Kendall Green	60
• Lowell Line		
	Lowell	470
	Wedgemere	103
	West Medford	30
• Ipswich Line		
	Ipswich	170
	Hamilton/Wenham	85
• Rockport Line		
	Rockport	
	Gloucester	
	Manchester	71
	Prides Crossing	60
	Beverly Depot	200

1 At Providence Station, no specific parking areas are designated for rail passengers. An adjoining public garage, however, can be used at a reduced rate.

Table 3.9 Boston-Portland Intercity Rail Service Ridership Daily Roundtrips at Originating Station

Station	2010 Rail	2010 Rail Integrated Bus
Portland	643	718
Saco	236	335
Wells	288	319
Dover	432	445
Exeter	175	251
Haverhill	500	636
Boston	402	667
Total	**2,676**	**3,371**

Source: Maine DOT – 1993.

Table 3.10 Burlington Commuter Rail Corridors Daily One-Way Trips

Corridor	2003 (Low)	2003 (High)
Barre-Burlington	126	178
Rutland-Burlington	209	209
St. Albans-Burlington	248	248

Table 3.11 New England Inter/Intra State Rail Movements

From the 1992 ICC Carload Waybill Sample (in hundred thousand net tons)

	CONNECTICUT					MAINE				
COMMODITY TYPE	1992 ORIGIN	1992 TERM	1992 TOTAL	2000 LOW GROWTH TOTAL	2000 HIGH GROWTH TOTAL	1992 ORIGIN	1992 TERM	1992 TOTAL	2000 LOW GROWTH TOTAL	2000 HIGH GROWTH TOTAL
GRAIN PRODUCTS	0	2	2	2	2	0	1	1	1	1
FARM PRODUCTS (EXCEPT GRAIN)			0	0	0			0	0	0
METALLIC ORES			0	0	0			0	0	0
COAL			0	0	0	2	2	4	4	5
CRUSHED STONE, GRAVEL AND SAND	5	6	11	12	13	1	1	2	2	2
NON- METALLIC MINERALS			0	0	0	0	1	1	1	1
GRAIN MILL PRODUCTS	0	2	2	2	2	0	2	2	2	2
FOOD AND KINDRED PRODUCTS	0	2	2	2	2			0	0	0
PRIMARY FOREST PRODUCTS			0	0	0	8	8	16	17	19
LUMBER AND WOOD PRODUCTS	0	4	4	4	5	5	1	6	6	7
PULP AND PAPER PRODUCTS	0	4	4	4	5	20	6	26	28	30
CHEMICAL PRODUTS	1	3	4	4	5	1	5	6	6	7
PETROLEUM PRODUCTS			0	0	0	3	4	7	8	8
STONE, CLAY & GLASS PRODUCTS			0	0	0	0	9	9	10	11
COKE			0	0	0			0	0	0
METAL AND METAL PRODUCTS	0	4	4	4	5			0	0	0
TRANSPORTATION EQUIPMENT			0	0	0			0	0	0
WASTE AND SCRAP MATERIALS	2	0	2	2	3	1	1	2	2	3
FORWARDER & SHIPPER			0	0	0			0	0	0
ALL OTHER			0	0	0			0	0	0
TOTAL	8	27	-	-	-	41	41	-	-	-
TOTAL VOLUME	35		35	38	42	82		82	89	97

Table 3.11 New England Inter/Intra State Rail Movements (continued)

From the 1992 ICC Carload Waybill Sample (in hundred thousand net tons)

	MASSACHUSETTS					NEW HAMPSHIRE				
COMMODITY TYPE	1992 ORIGIN	1992 TERM	1992 TOTAL	2000 LOW GROWTH TOTAL	2000 HIGH GROWTH TOTAL	1992 ORIGIN	1992 TERM	1992 TOTAL	2000 LOW GROWTH TOTAL	2000 HIGH GROWTH TOTAL
GRAIN PRODUCTS	1	2	3	3	4			0	0	0
FARM PRODUCTS (EXCEPT GRAIN)	0	2	2	2	2			0	0	0
METALLIC ORES			0	0	0			0	0	0
COAL	0	4	4	4	5	0	11	11	12	13
CRUSHED STONE, GRAVEL AND SAND	0	5	5	5	6	4	0	4	4	5
NON- METALLIC MINERALS	0	3	3	3	4	0	1	1	1	1
GRAIN MILL PRODUCTS	1	6	7	8	8	0	1	1	1	1
FOOD AND KINDRED PRODUCTS	0	6	6	6	7	0	1	1	1	1
PRIMARY FOREST PRODUCTS			0	0	0			0	0	0
LUMBER AND WOOD PRODUCTS	0	7	7	8	8	0	2	2	2	2
PULP AND PAPER PRODUCTS	1	10	11	12	13	1	0	1	1	1
CHEMICAL PRODUTS	2	9	11	12	13	0	2	2	2	2
PETROLEUM PRODUCTS	0	1	1	1	1			0	0	0
STONE, CLAY & GLASS PRODUCTS	1	5	6	6	7			0	0	0
COKE			0	0	0			0	0	0
METAL AND METAL PRODUCTS	0	1	1	1	1			0	0	0
TRANSPORTATION EQUIPMENT	2	6	8	9	12			0	0	0
WASTE AND SCRAP MATERIALS	2	1	3	3	4			0	0	0
FORWARDER & SHIPPER			0	0	0			0	0	0
ALL OTHER	8	13	21	31	36			0	0	0
TOTAL	18	81	-	-	-	5	18	-	-	-
TOTAL VOLUME	99		99	115	131	23		23	25	27

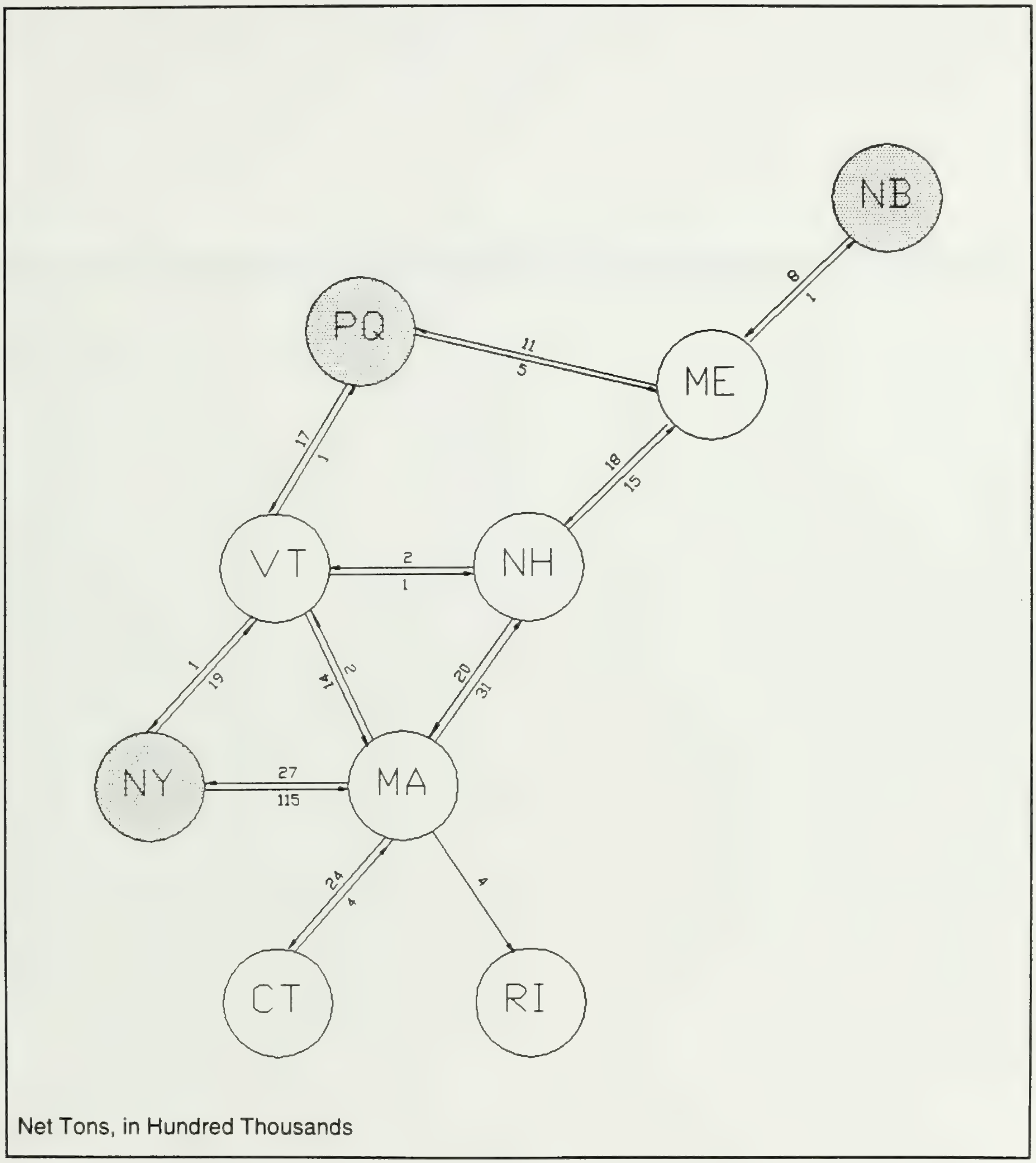
Table 3.11 New England Inter/Intra State Rail Movements (continued)

From the 1992 ICC Carload Waybill Sample (in hundred thousand net tons)

	RHODE ISLAND					VERMONT				
COMMODITY TYPE	1992 ORIGIN	1992 TERM	1992 TOTAL	2000 LOW GROWTH TOTAL	2000 HIGH GROWTH TOTAL	1992 ORIGIN	1992 TERM	1992 TOTAL	2000 LOW GROWTH TOTAL	2000 HIGH GROWTH TOTAL
GRAIN PRODUCTS			0	0	0	0	2	2	2	2
FARM PRODUCTS (EXCEPT GRAIN)			0	0	0			0	0	0
METALLIC ORES			0	0	0			0	0	0
COAL			0	0	0			0	0	0
CRUSHED STONE, GRAVEL AND SAND			0	0	0			0	0	0
NON- METALLIC MINERALS			0	0	0	0	2	2	2	2
GRAIN MILL PRODUCTS			0	0	0	0	1	1	1	1
FOOD AND KINDRED PRODUCTS	0	1	1	1	1	0	1	1	1	1
PRIMARY FOREST PRODUCTS			0	0	0	1	1	2	2	2
LUMBER AND WOOD PRODUCTS			0	0	0	0	1	1	1	1
PULP AND PAPER PRODUCTS			0	0	0	0	2	2	2	2
CHEMICAL PRODUTS	0	2	2	2	2			0	0	0
PETROLEUM PRODUCTS			0	0	0	0	16	16	17	19
STONE. CLAY & GLASS PRODUCTS			0	0	0	3	1	4	4	5
COKE			0	0	0			0	0	0
METAL AND METAL PRODUCTS			0	0	0			0	0	0
TRANSPORTATION EQUIPMENT			0	0	0			0	0	0
WASTE AND SCRAP MATERIALS	0	1	1	1	1			0	0	0
FORWARDER & SHIPPER			0	0	0			0	0	0
ALL OTHER			0	0	0			0	0	0
TOTAL	0	4	-	-	-	4	27	-	-	-
TOTAL VOLUME	4		4	4	5	31		31	34	36

Figures

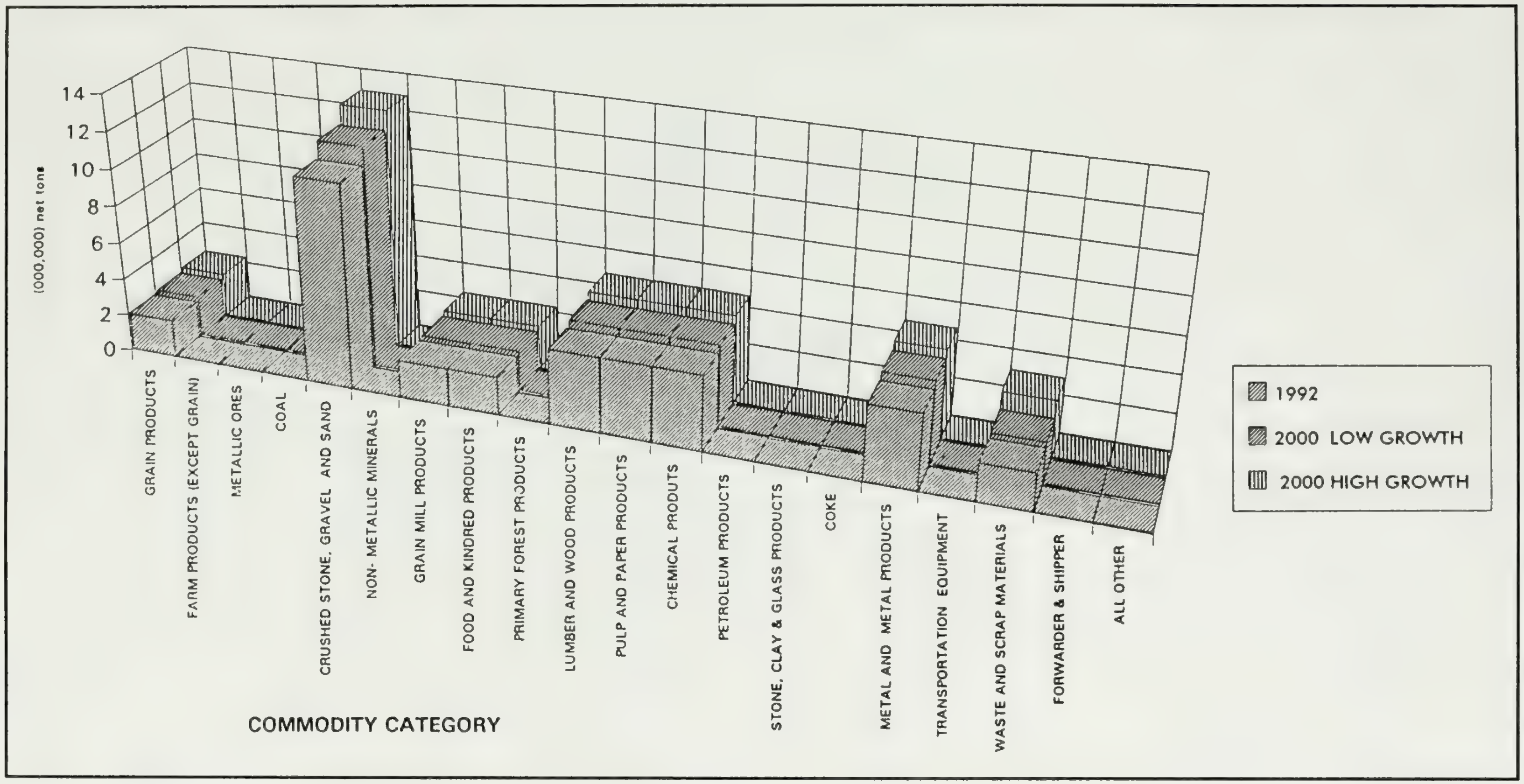
Figure 3.1 State-to-State Rail Movements from the 1992 ICC Carload Waybill Sample



Source: "Railroad Traffic in the United States – 1992," ALK Associates, 1993.

Figures

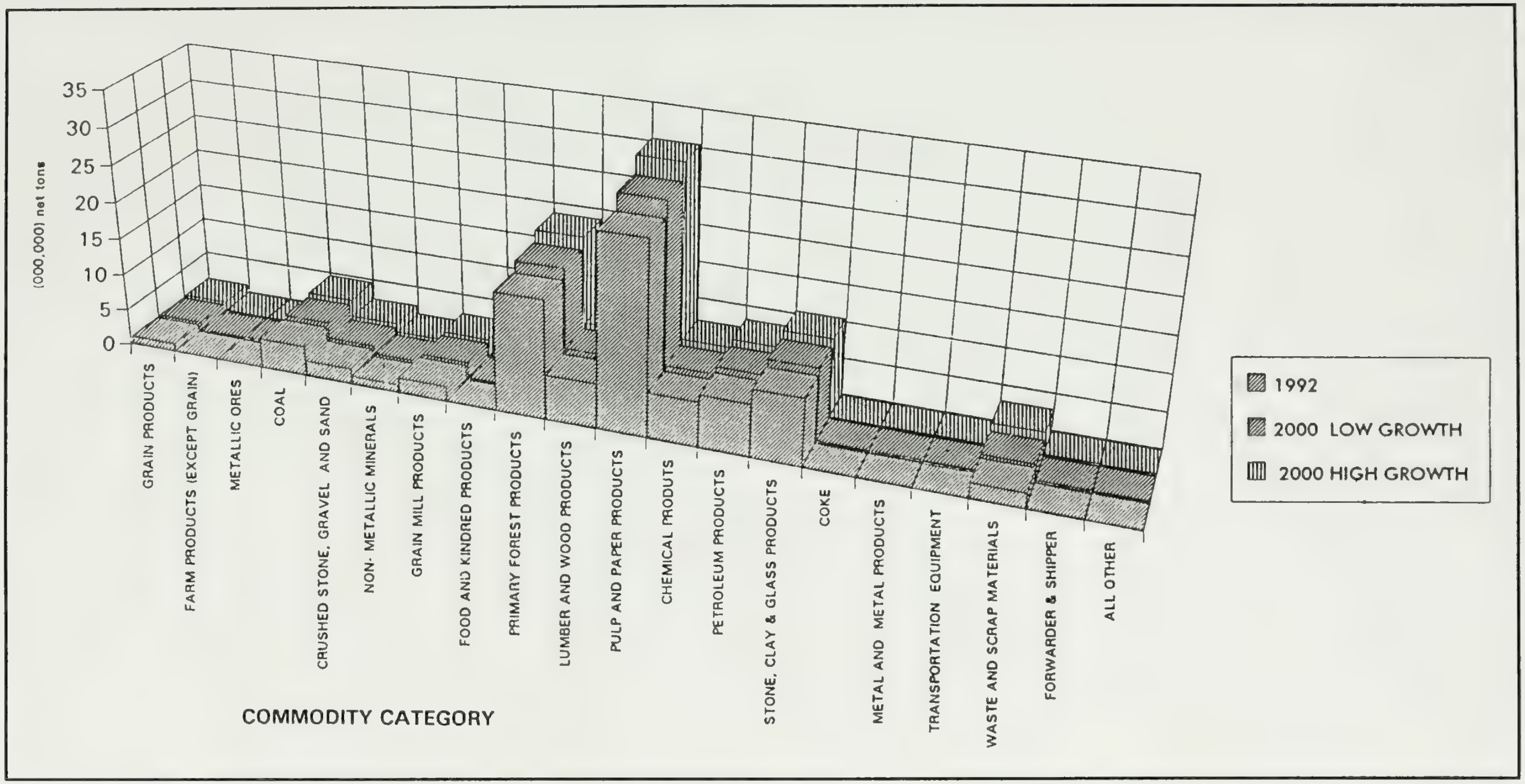
Figure 3.2 Connecticut Intra/Inter-State Rail Movements by Commodity
(Net Tonnage – Originations and Terminations)



Source: "Railroad Traffic in the United States – 1992," ALK Associates, for Present Year Data.

Figure 3.3 Maine Intra/Inter-State Rail Movements by Commodity

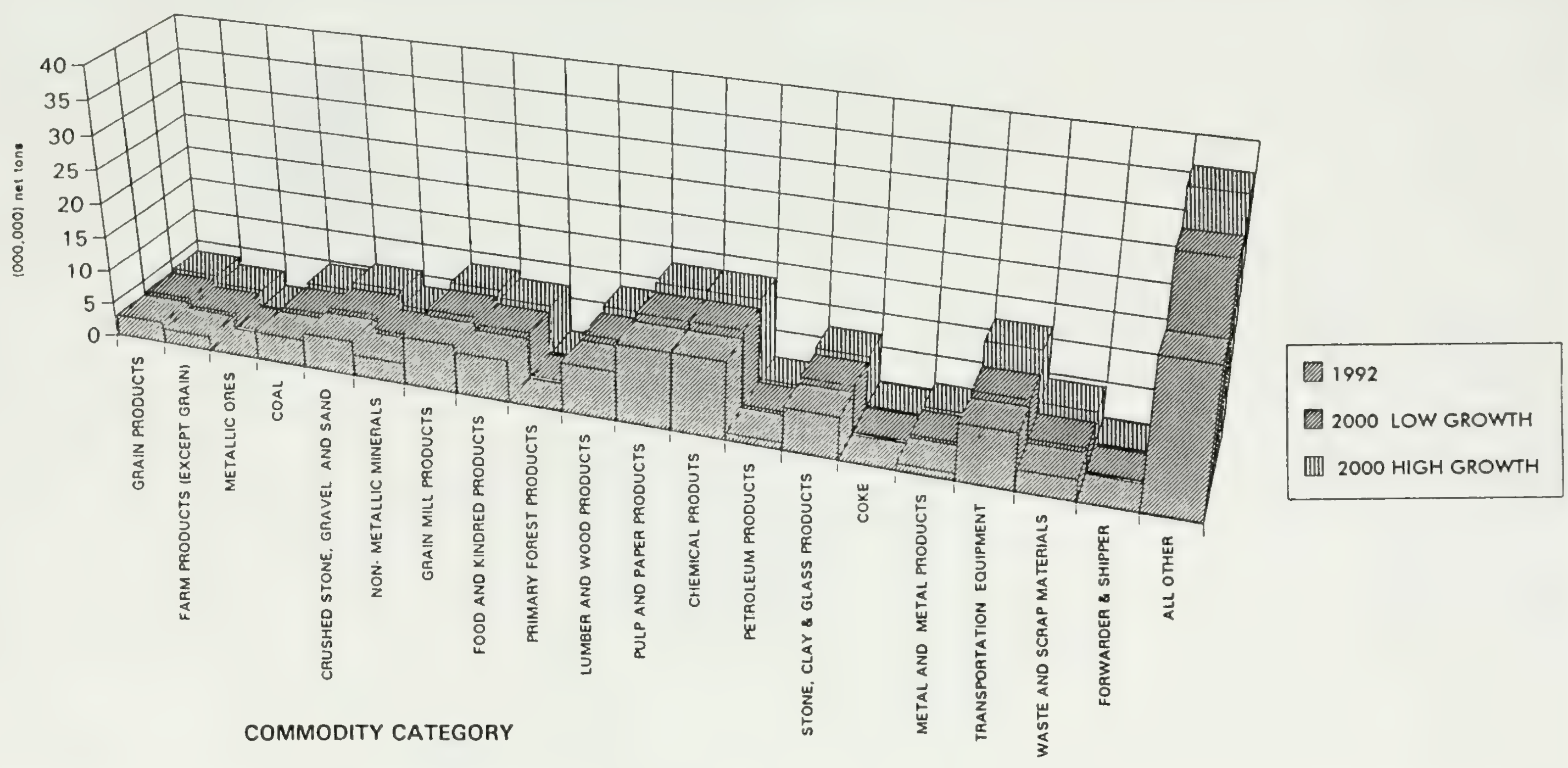
(Net Tonnage – Originations and Terminations)



Source: "Railroad Traffic in the United States – 1992," ALK Associates, for Present Year Data.

Figure 3.4 Massachusetts Intra/Inter-State Rail Movements by Commodity

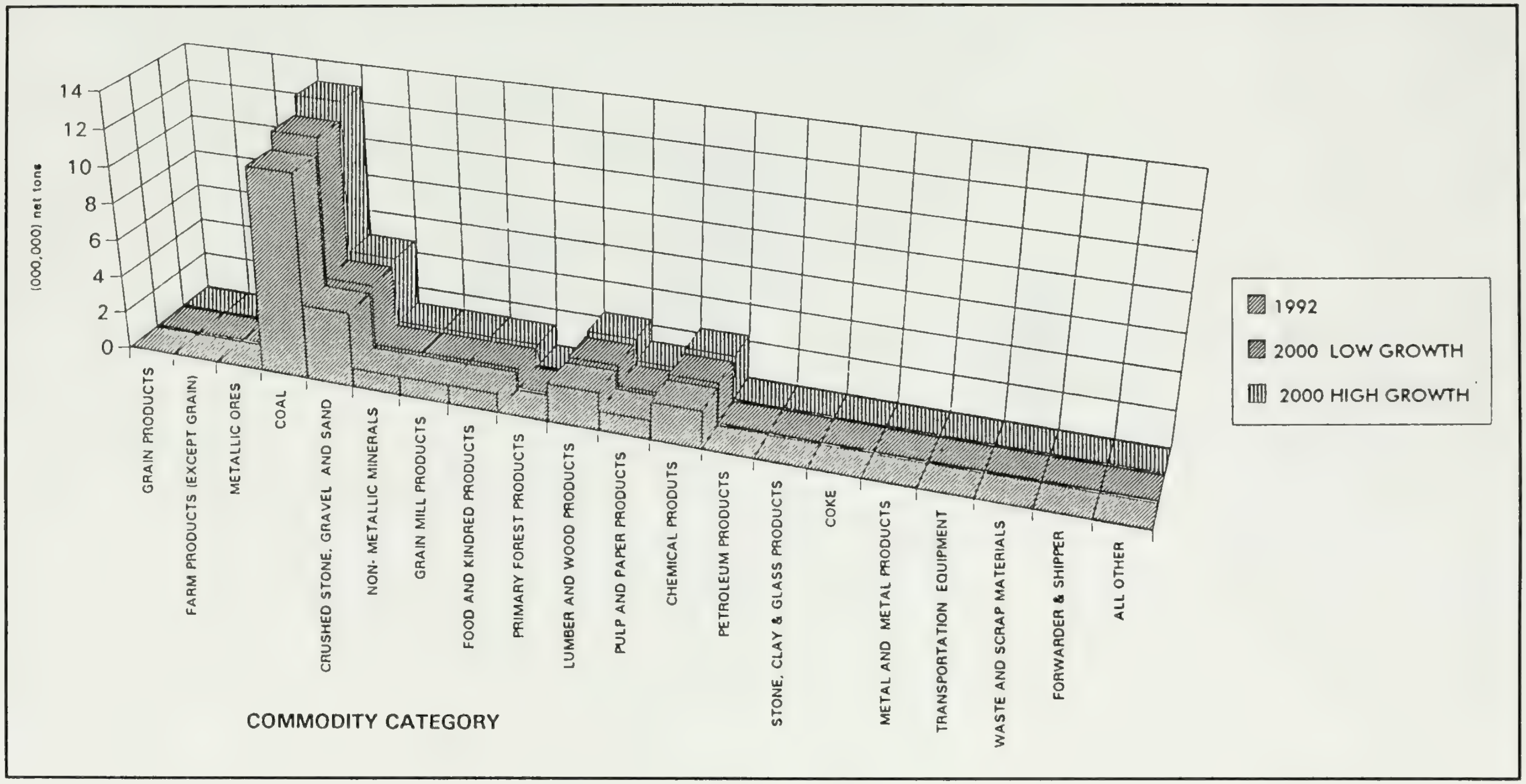
(Net Tonnage – Originations and Terminations)



Source: "Railroad Traffic in the United States – 1992," ALK Associates, for Present Year Data.

Figure 3.5 New Hampshire Intra/Inter-State Rail Movements by Commodity

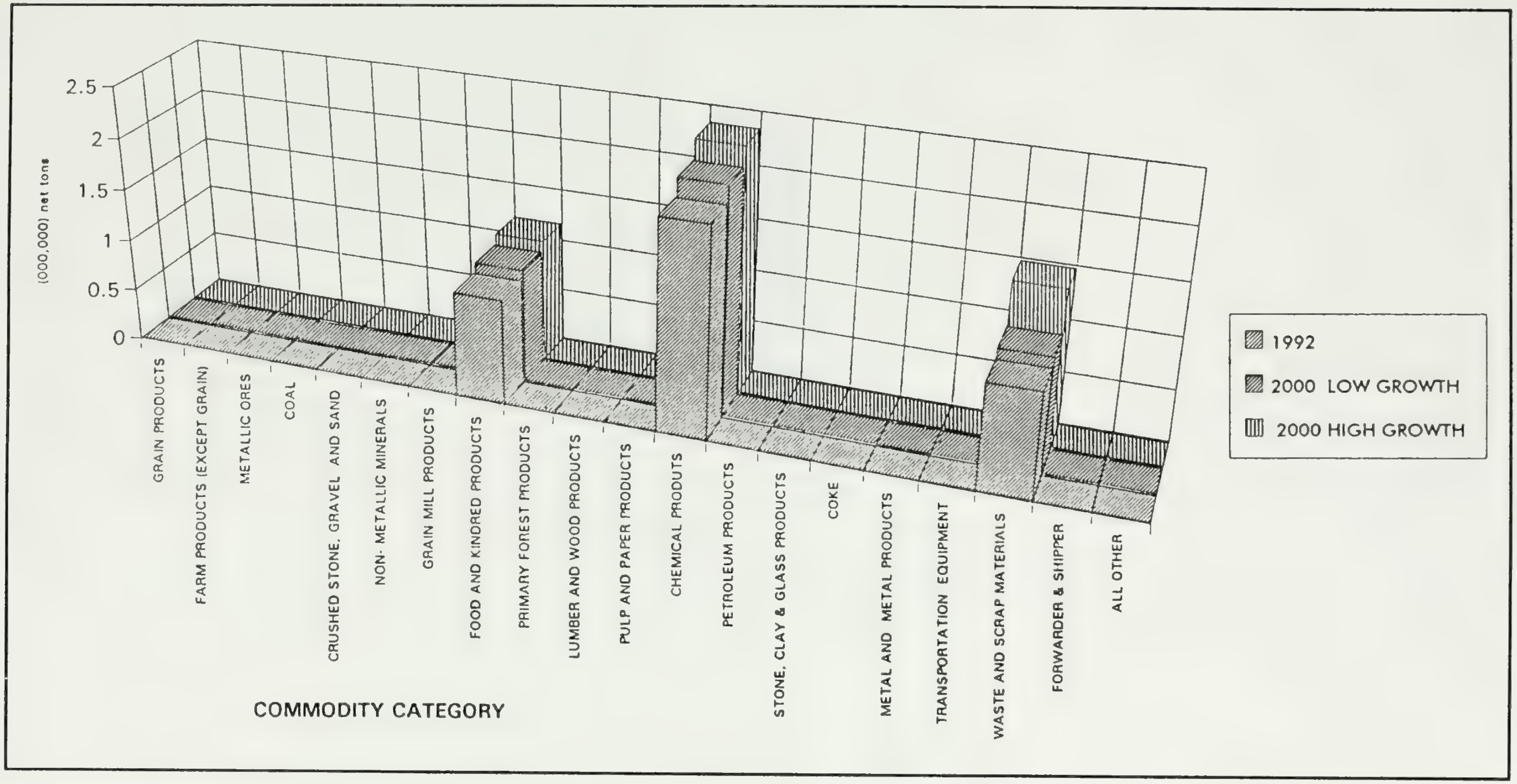
(Net Tonnage – Originations and Terminations)



Source: "Railroad Traffic in the United States – 1992," ALK Associates, for Present Year Data.

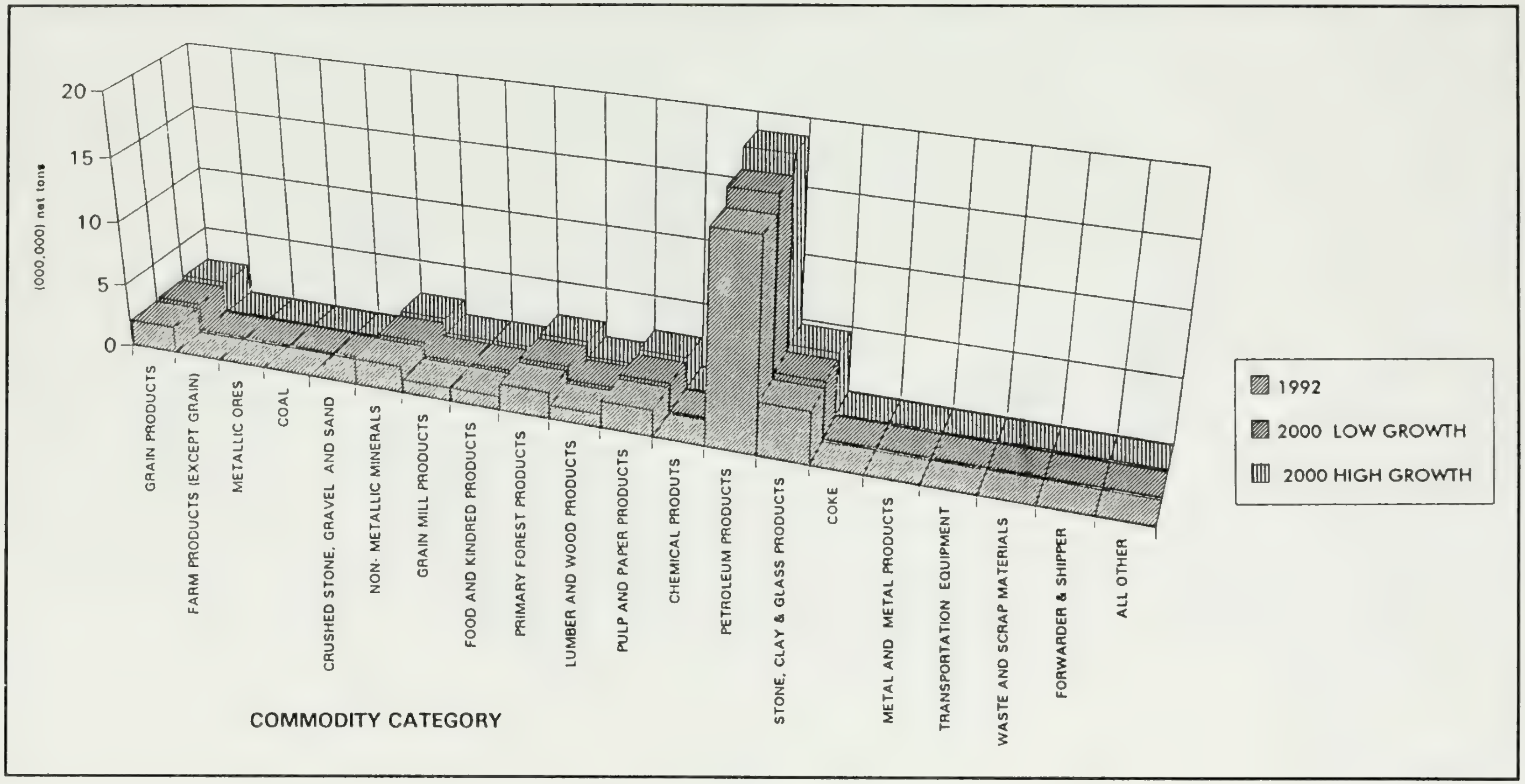
Figure 3.6 Rhode Island Intra/Inter-State Rail Movements by Commodity

(Net Tonnage – Originations and Terminations)



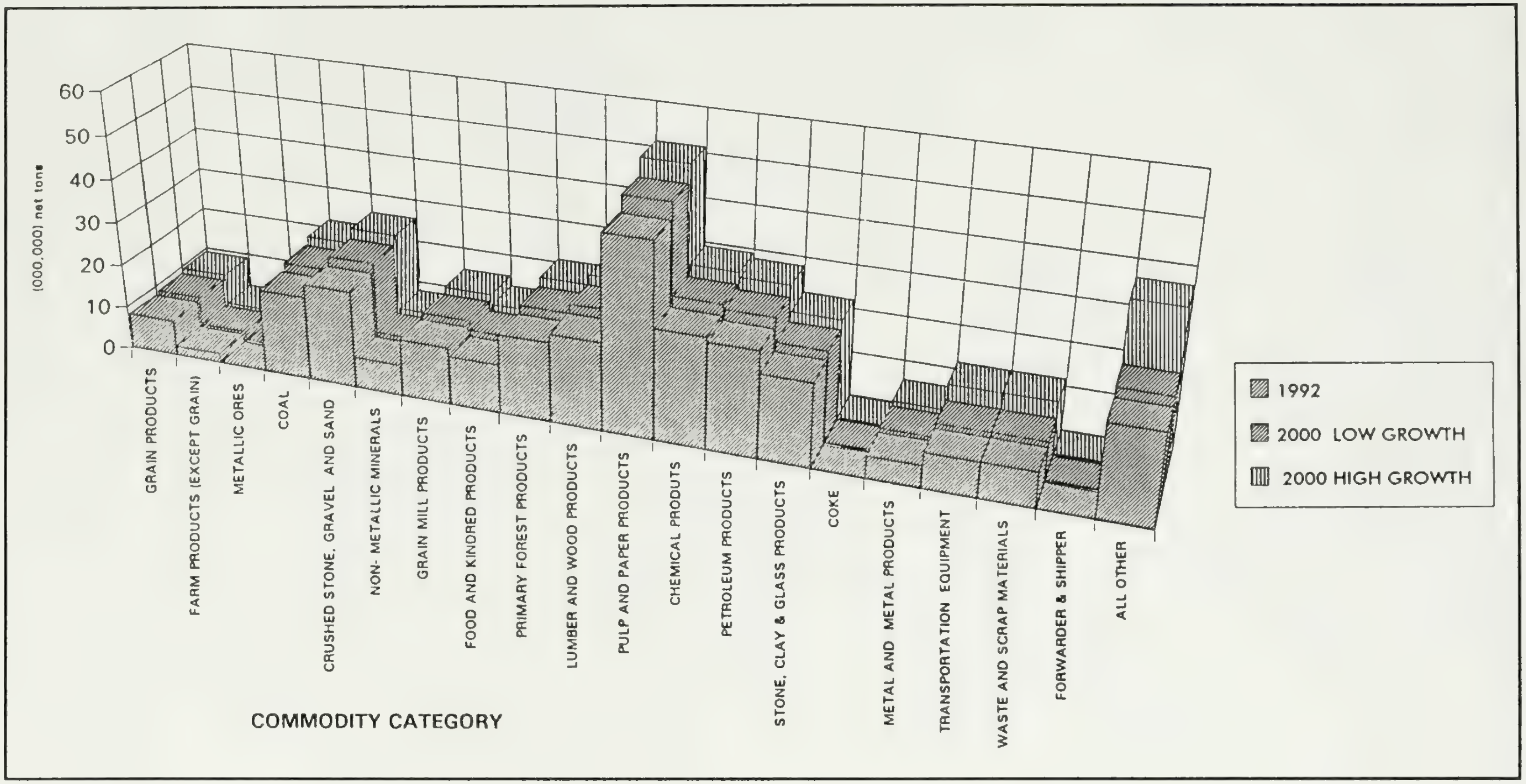
Source: "Railroad Traffic in the United States – 1992," ALK Associates, for Present Year Data.

Figure 3.7 Vermont Intra/Inter-State Rail Movements by Commodity
(Net Tonnage – Originations and Terminations)



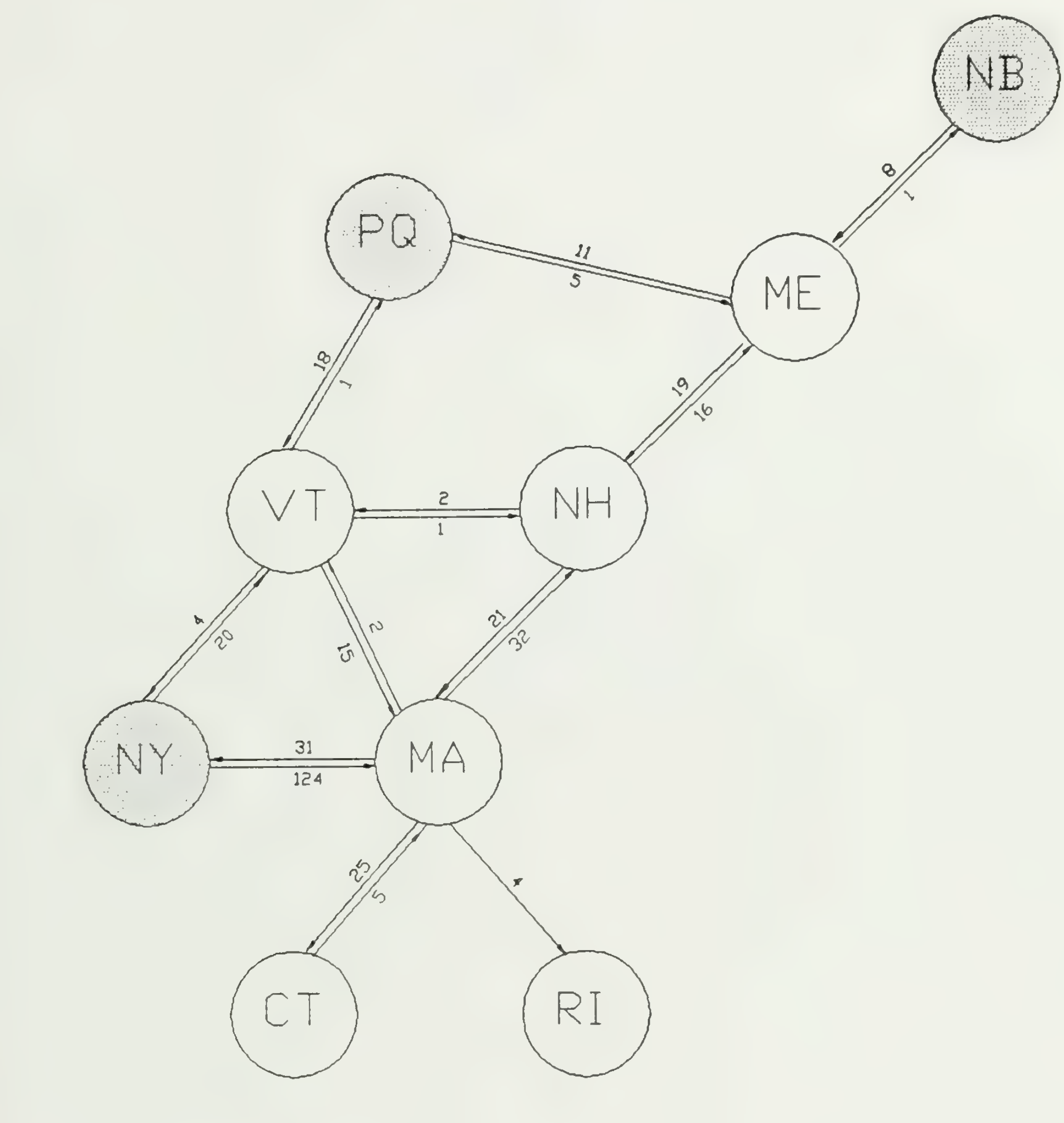
Source: "Railroad Traffic in the United States – 1992," ALK Associates, for Present Year Data.

Figure 3.8 New England Intra/Inter-State Rail Movements by Commodity
(Net Tonnage – Originations and Terminations)



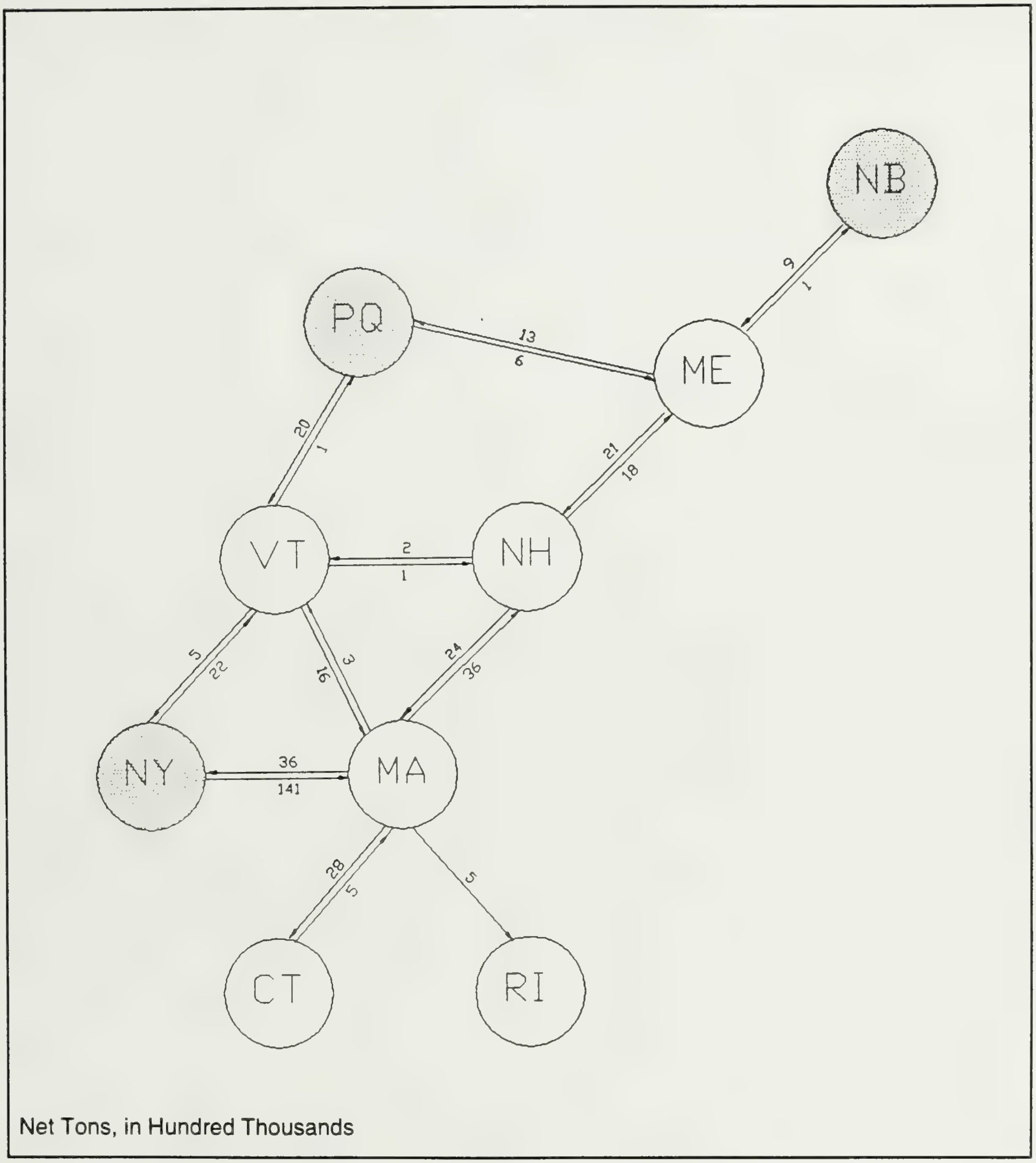
Source: "Railroad Traffic in the United States – 1992," ALK Associates, for Present Year Data.

Figure 3.9 State-to-State Rail Movements, 2000 Low Growth Forecast



Net Tons, in Hundred Thousands

Figure 3.10 State-to-State Rail Movements, 2000 High Growth Forecast



4.0 Airports

4.0 Airports

4.1 Trends Assessment

The air transportation industry is constantly reshaping itself, reacting to market pressures. Currently, the airlines are primarily concerned with regaining profitability following record losses in the early 1990s. As a result, expected trends include higher yields, lower operating costs, the removal of jet service from short-range markets where turboprop aircraft are more profitable, and increased consolidation of airlines. A significant regional outcome of these national trends is relatively strong growth in the commuter (or regional) airline operations. This is reflected in FAA's relatively high prediction for commuter enplanements. While average aircraft size is expected to increase both in air carrier and commuter operations, the shift from air carrier jet to commuter turboprop and/or regional jet services in short-haul markets will initially result in a lower overall capacity. Other cost cutting measures include the emergence of low-cost short-haul airlines such as Southwest Airlines, Continental Lite, and United's proposed U2.

To a large extent, aviation trends in New England mirror changes at the national level. Overall, commercial passenger and cargo activity are beginning to rebound in North America, with eight percent growth in enplanements and nine percent growth in cargo from January to October 1993.[1] The FAA predicts the following average annual growth rates through the year 2004:[2]

Domestic air carrier enplanements	3.5%
International air carrier enplanements	6.6%
Atlantic	5.4%
Latin American	7.0%
Pacific	7.3%
Commuter enplanements	8.4%
General aviation hours flown	1.4%
Single-engine (excl. turbine)	0.3%
Twin-engine (excl. turbine)	0.7%
Turbine aircraft	3.0%
Turbine rotorcraft	7.4%

For New England airports, this implies a gradual rebound in air carrier activity, with stronger growth in the commuter markets. Increased demand on transatlantic routes will

1/ "Worldwide Passenger Traffic Increases in October, ACI Says," Airports, January 25, 1994, p. 30.

2/ Department of Transportation, Federal Aviation Administration, FAA Aviation Forecasts: Fiscal Years 1993-2004, February 1993.

to some extent drive overall growth at Logan; this segment alone grew 23 percent from 1991 to 1992.[3] Overall, international traffic increased from 14.4 percent to 15.5 percent of total enplanements.

Growth in international traffic is one of the causes for the increased number of commuter passengers from New England's regional airports to Logan. While some regional airports are now able to compete with Logan in terms of non-stop service to short and medium-haul destinations, Logan remains the only airport in New England with significant transatlantic services (charter market at Bangor excepted). Growth in commuter passengers at Logan has increased steadily since 1990, at an average annual growth rate of 14.1 percent while air carrier enplanements have not regained their 1990 peak. In FY 1990, commuter flights accounted for 35 percent of all operations at Logan and seven percent of all enplanements. By FY 1993 these values had increased to 44 percent and 10 percent, respectively.

Logan is the only New England airport which experiences significant air-side and ground-side congestion. Its role as the New England hub of international and long-haul domestic services requires maintenance of effective access to it from other New England airports, or to the diversion of some Logan functions to other facilities. The growth in international and commuter flights, and the trend toward smaller planes (requiring greater frequency) servicing small airports, will place increasing demand pressure on Logan's air-side capacity.

The forecast for general aviation activity depicts a much less positive picture than that for either air carrier or commercial enplanements. Only business-related turboprop and helicopter activity are expected to experience moderate growth, and these account for a relatively small share of all general aviation operations. Recreational, training, and piston engine business aircraft activity is expected to remain stable at best. The number of active general aviation aircraft in New England has remained relatively constant at 8,300 in the 1987-1992 period. The FAA projects a slight increase to 8,700 by the year 2000. Growth rates for total general aviation operations at small airports (i.e., without control towers) are presented in Table 4.1 as an additional indicator of the static state of general aviation in the region.

Trends in funding of airport projects include increased reliance on Passenger Facility Charges (PFC) up to $3 levied on each passenger. The PFC program primarily aids airports with significant levels of commercial enplanements and is not intended to replace the Airport Improvement Program (AIP). Nonetheless, current AIP reauthorization proposals in Congress are at reduced levels from 1993. Table 4.2 lists PFC applications approved in New England to date. These airports account for approximately two-thirds of the airports identified in this study as regionally significant.

3/ Massachusetts Port Authority, Massport Response to SAR, p. 3, 1993

4.2 Forecasting

Two forecasts were developed for this study. The first assumes no significant level of demand diversion due to telecommunications or alternative transportation modes. The source for this forecast is the Terminal Area Forecasts (TAF) developed by the FAA. The TAF forecasts essentially form an upper bound of aviation activity in New England. They represent a scenario where the regional economy is able to rebound, with consequent growth in demand for both business and pleasure air travel. Competition from other travel modes is not considered.

The alternate forecast represents a lower bound of potential future activity. It includes two basic assumptions: (1) there will be a significant level of diversion of air travelers from airports to rail following electrification of the Northeast rail corridor and construction of a Portland-Boston passenger rail line; and (2) the regional airport growth will be capped at the low estimate of economic growth discussed during the inventory phase.[4] The primary source to determine the diversion from air to rail were the Environmental Impact Statements prepared for the Northeast Corridor electrification project and the proposed Portland-Boston line. The only routes affected by rail diversion under these assumptions are Boston-New York City, Providence-New York City, and Portland-Boston. In computing this diversion it was assumed that only passengers with origins and destinations in these cities would switch from air travel to rail.

In order to evaluate trends and the merits of the forecasts, historical enplanements were collected for each of the airports on a fiscal year basis. To the greatest extent possible, the historical data presented in the FAA's Terminal Area Forecasts were used. However, since these are only available through FY 1991, FY 1992 and 1993 data was obtained from other sources. In some cases it was necessary to make estimates, for example by using calendar year data as approximations of fiscal year data. Historical enplanement values collected for fiscal years 1978-1993 are summarized in Tables 4.3 and 4.4. Comparisons of the individual airport forecasts with historical data and known trends indicate that the projections generally appear to be reasonable estimates of aviation growth under the assumptions discussed above.

Forecasts are presented below for each of the nine airports included for specific analysis in this study. The attached figures graphically demonstrate historical trends and projections for the year 2000. While a linear trend is shown in each case between 1993 and 2000, this is primarily for the sake of convenience and should be treated as a simple approximation of actual trends. For the purposes of this analysis gradual growth/decline is defined as less than three percent average annual rate of change, moderate is three to six percent, and strong is greater than six percent.

4/ Fourteen percent total economic growth for New England in the 1993-2010 period, as identified in the Inventory Report.

The forecast results are discussed below on an airport-by-airport basis. The FAA TAF forecast used as a base case is reviewed first, followed by a discussion of the alternate forecast. Historic and projected trends are shown by airport in Figures 4.1-4.9.

4.2.1 Bradley International Airport (CT)

The trend of total enplanements at Bradley over the last 15 years, can be categorized into three basic periods:

1979-1982 - Strong decline (about 9 percent/year)
1982-1988 - Strong growth (about +12.2 percent/year)
1988-1993 - Gradual decline (about 1 percent/year)

In general, enplanement levels tend to follow the same cycles as the economy. It is interesting to note that the rate of decline in the current recession is much lower than it was during 1979-1982. The rate of recovery, however, is also slower. Recently announced statistics for 1993 show a 0.6 percent decline over the previous year.

The high forecast based on the FAA Terminal Area Forecast for 2000 represents a 4.9 percent average annual growth for the remainder of the decade. Assuming continued economic growth, this appears to be reasonable given Bradley's historic trend. Currently, Bradley remains underserved when compared to its market catchment area. If services and frequencies improve at the airport, moderate growth at the levels predicted by the FAA is reasonable.

Under the assumption developed above, no diversion to rail is expected at Bradley. The alternate forecast results in an average annual growth of 0.6 percent based on the assumption that activity at the airport will grow no faster than the predicted economic growth in New England.

4.2.2 Logan International Airport (MA)

The analysis of demand at Logan has been the focus of considerable attention. This is partly due to the fiscal, political, and environmental considerations of accommodating additional growth at Logan. At least six substantial forecast efforts have been conducted since 1989. The most recent demand analysis was conducted as part of the Strategic Assessment Report. This effort is of particular value to the NETI study since it evaluated the role of telecommunications, regional airports, and alternate modes of transportation.

The historical trend of total enplanements at Logan largely reflects that of the rest of the region, but with more gradual changes. The following is a summary of the growth pattern at Logan during the last 15 years:

1979-1981 - Gradual decline (about 1 percent/year)
1981-1988 - Strong growth (about +7 percent/year)
1988-1991 - Moderate decline (about 4 percent/year)
1991-1993 - Moderate growth (about +5 percent/year)

The FAA year 2000 TAF forecast represents a 4.0 percent average annual growth. This is considerably less than the 1981-1988 growth pattern and somewhat less than the growth experienced since 1991. It is, however, somewhat higher than the long-term 3.0 percent growth rate experienced at Logan over the last 15 years. Hence, given continued economic growth and no significant diversion to other modes or technologies, the FAA TAF forecast appears credible.

The low forecast for Logan includes a lower growth rate capped at the projected economic growth as well as a reduction in activity due to diversion to rail. The latter was computed based on a model developed by Charles River Associates for the environmental analysis of the proposed electrification of the Northeast rail corridor. This analysis concluded a 34 percent diversion potential in the Boston-New York City market by 2010. This market accounts for approximately 15 percent of all enplanements at Logan. This result was modified to compute a diversion factor for the year 2000. The resulting diversion by the year 2000 is estimated at 330,000 annual enplanements, yielding a forecast with an average annual growth rate of 0.2 percent.

4.2.3 Worcester Municipal Airport (MA)

Worcester has probably experienced the most dynamic trend of all major airports in New England. The airport faces considerable challenges in the areas of airport closures due to weather, ground access, and other issues (see Inventory Report for a more detailed discussion). As such, Worcester has not been able to fully capitalize on its market potential and has experienced frequent changes in airline service. The resulting trend is summarized below:

1979-1982 - Strong decline (about 38 percent/year)
1982-1989 - Strong growth (about +53 percent/year)
1989-1993 - Strong decline (about 15 percent/year)

The FAA TAF projection for the year 2000 results in a 6.8 percent average annual rate of growth. While this would normally be a very high sustained growth rate for an airport, the resulting 2000 projection is below the historical activity achieved in the airport's two peak years, 1988 and 1989. The airport staff is currently conducting discussions with airlines to obtain improved service. Other improvements are also planned to address the constraints facing the facility (see Inventory Report). The FAA projection could be achieved with capital and service improvements in place at the airport. Furthermore, if, as has been suggested by Massport and the Worcester Municipal Research Bureau, Worcester becomes a designated regional airport to relieve Logan, activity may increase to levels considerably above those projected by the FAA. The Worcester Municipal Research Bureau (an

independent public research group) reports that the potential demand for the airport is in the range of 300,000-400,000 annual enplanements.

The low forecast for Worcester was developed by capping growth at the projected rate of growth in the regional economy. The result is an average annual growth rate of 0.6 percent.

4.2.4 Bangor International Airport (ME)

Bangor experienced strong growth in the late 1980s and early 1990s, peaking in 1991. This was primarily due to the airport's ability to capture a niche market of serving as a stop for transatlantic charters. This segment of Bangor's traffic accounts for approximately 60 percent of its annual enplanements. The apparent jump in enplanements from 1988 to 1989 as reported by the FAA is misleading, however. The depicted increase from 281,000 to 836,000 enplanements is due to a change in the FAA's methodology for counting enplanements at Bangor. For this reason, it is not possible to compute a meaningful average annual growth rate for Bangor. Since the peak in 1990, total annual enplanements have declined at an average annual rate of approximately 12 percent.

The FAA forecast for 2000 would represent a very substantial level of growth. The projected average annual growth rate is 11.8 percent. Given the fact that Bangor serves a very unique market, this forecast appears optimistic given the airport's recent record. The high growth projected by the FAA Terminal Area Forecasts is based primarily on the strong growth in international charter operations at Bangor. This growth occurred up to 1991, the base year for the FAA forecasts. However, the FAA projections do not segregate international charter and domestic scheduled enplanements at Bangor. In order to identify the effect of international charter activity on the forecasts, the distribution between domestic and international enplanements was estimated. This was achieved by assuming that the average annual growth rate in international enplanements is the same as the growth rate in air carrier enplanements, as projected by the FAA. The underlying assumption is that air carrier activity at Bangor is dominated by international charter operations. The results are depicted in Table 4.5. For the high forecast, international charter enplanements are estimated to grow at an average annual rate of 18.8 percent versus 5.1 percent for domestic scheduled enplanements. The low forecast assumes that the current distribution between domestic and international enplanements will remain constant.

The high growth in international charter enplanements projected by the FAA for Bangor International Airport highlights the significance of this market on the airport's overall level of passenger activity. Future levels of activity at Bangor will to a large extent depend on the airport's ability to continue marketing itself to charter operators. To date, the airport management has been aggressive in ensuring a competitive environment, complemented by an ambitious airport improvement program. Because of Bangor's unique role among New England's airports, there is a high level of uncertainty inherent to projections of activity at this facility.

The low forecast for Bangor was determined by capping growth at the projected level of total regional economic growth. This resulted in an average annual growth rate of 0.6 percent.

4.2.5 Portland International Jetport (ME)

The historical trend of total enplanements at Portland International Jetport is summarized below:

1979-1982 - Moderate decline (about 6 percent/year)
1982-1988 - Strong growth (about 19 percent/year)
1988-1993 - Gradual decline (about 3 percent/year)

The FAA forecasts result in a projected average annual growth rate of 4.7 percent for the remainder of the decade. While this represents a high level of sustained growth, it is not unfeasible given the airport's historical record during the mid-1980s. Such growth would only be possible if accompanied by strong regional economic growth throughout the planning horizon.

The alternative forecast for Portland was developed by capping growth at the projected regional economic growth rate and by computing diversion of passengers to the proposed Portland-Boston passenger rail line. The environmental analysis for this project does not include a measure of diversion from other travel modes. The Portland-Boston air travel market only consists of 3.6 percent of all enplanements, however. A relatively high level of diversion was assumed (80 percent by 2010), resulting in approximately 10,000 annual enplanements being diverted from air travel to rail. The resulting low forecast has an average annual growth rate of 0.4 percent.

4.2.6 Manchester Airport (NH)

Manchester Airport has experienced one of the most consistent growth patterns among all of New England's major airports. This is due to a combination of continuous facility improvements, aggressive marketing, good weather reliability and ground access, and proximity to demand centers. The historical trend at Manchester is described below:

1979-1982 - Strong decline (about 19 percent/year)
1982-1990 - Strong growth (about +34 percent/year)
1990-1993 - Moderate growth (about +5 percent/year)

The FAA forecast for 2000 results in an average annual growth rate of 5.0 percent. This level of growth appears very reasonable, given the airport's record of consistent growth since 1982. Recent infrastructure improvements at the airport, in particular the construction of a new airline terminal, makes the facility well suited for accommodating additional growth. Furthermore, the airport staff and the City of Manchester are actively marketing the airport with the goal to improve service. If this effort succeeds, it is entirely

possible that growth at the airport over the next few years will exceed the projections computed by the FAA.

The low forecast for Manchester Airport was computed by assuming growth in enplanements to be the same as the total regional economic growth. The resulting activity projection yields a 0.6 percent average annual growth rate.

4.2.7 Pease International Tradeport (NH)

The airport at Pease International Tradeport reported 24,821 enplanements for FY 1993. However, since this only includes seven months of airline activity, a more representative value is the estimated number of enplanements for the first 12 months of operation. This is currently projected at 40,000 enplanements. Since this is the first year of service, there is no trend line to assess. However, it should be noted that 40,000 enplanements exceeds the short-term forecast adopted in the facility's comprehensive redevelopment plan. This is partially due to low incentive fares, such as $19 for a one-way ticket from Pease to Boston. At the time of writing, some of these incentive fares are still in place.

The ongoing Airport Master Plan for Pease will take a comprehensive approach in estimating the potential demand for the airport. For the purposes of this study however, it was necessary to develop an independent projection of demand for the year 2000. Pease is currently not in the set of airports listed in the FAA's TAF.

The approach used here is similar to that adopted for the Pease Part 150 Noise Compatibility Study, which is also in progress. This ensures consistency between the studies, as well as a natural progression of continuous updates since the original 1990 Comprehensive Redevelopment Plan. The approach is to essentially adopt the forecast presented in that plan, with minor revisions to reflect the latest knowledge on the demand for airline services at the site.

In the preferred forecast scenario, the Comprehensive Redevelopment Plan projected 26,500 air carrier and commuter operations for the year 2000. This was derived through consideration of the frequency and network of flights which would be consistent with the facility being considered in each scenario. It did not represent an attempt at measuring the market catchment potential of Pease, other than to ensure that the resulting levels of enplanements were consistent with the demographics of the region.

The only revision made to the Comprehensive Redevelopment Plan for this analysis was the assumption regarding fleet mix. The preferred development scenario selected by the Pease Redevelopment Commission included wide and narrow-body jet service by the year 2000. Given the recent trend of reduced system capacity on regional airport routes, and an emergence of commuter operators as a major service provider in New England, this assumption now appears in need of revision. While jet service similar to that provided at Manchester and Portland today is still projected to materialize at Pease, it is now assumed that this will occur beyond the year 2000. Instead, a fleet mix consisting of turboprops and

regional jets was assumed. The assumptions and resulting projections are listed in Table 4.6.

The resulting projection of 302,100 annual enplanements by the year 2000 results in an average annual growth rate of 33 percent. While this is nominally an extremely high rate of growth, it must be considered that the airport at Pease is still maturing. In fact, the growth rate would be similar to that experienced at Manchester Airport, which grew from 36,000 enplanements in 1982 to 379,000 by 1990. A market analysis conducted for Pease in 1992 estimated the airport's enplanement potential at 303,632 annual enplanements. It should be noted however, that the viability of long-term growth at Pease is yet to be established. Projections of activity at this airport must be viewed with a considerable degree of uncertainty.

The low forecast developed for Pease assumes that growth will occur at the same rate as that of the total regional economy. This results in an average annual growth rate of 0.6 percent. It is also possible that the Boston-Portland rail connection could impact the Pease growth rate.

4.2.8 T.F. Green State Airport (RI)

The trend at Providence very closely matches that seen at Bradley and Portland. Key periods of decline and growth include:

1979-1982 - Strong decline (about 11 percent/year)
1982-1990 - Strong growth (about +16 percent/year)
1990-1993 - Gradual decline (about 2 percent/year)

The FAA TAF projection for the year 2000 projects an average annual growth rate of 2.7 percent. Provided that the economy recovers, this is a modest growth rate and should be attainable within the assumptions of the high growth scenario.

The low forecast for Providence consists of two components – a baseline growth rate limited to the total growth rate of the regional economy and modified by projected diversion from air travel to rail in the Providence-New York City market in Providence. This market accounts for approximately four percent of all air travel enplanements. Applying the diversion rate of 80 percent, as estimated in the Northeast Corridor Improvement Project, to the affected market study of four percent, approximately three percent, or 20,000 of the annual enplanements in the year 2010 would switch from air travel to rail. The resulting annual average growth rate of the low forecast is 0.3 percent.

4.2.9 Burlington International Airport (VT)

Burlington has experienced a growth pattern which differs somewhat from the other regional airports in New England. Following strong growth in the 1982-1984 period,

Burlington has remained a zero growth airport during most of the last decade. The growth pattern at the airport is summarized below:

1979-1982 - Moderate decline (about 6 percent/year)
1982-1984 - Strong growth (about +60 percent/year)
1984-1993 - Stagnation (about 0.6 percent/year)

The FAA projects considerable growth for Burlington by the year 2000. The TAF average annual growth rate for the 1993-2000 period is 6.2 percent. This is a very high sustained growth rate for any airport in New England, and given Burlington's historical pattern it appears overly optimistic. Such a growth rate only appears realistic if strong economic expansion materializes in the airport's service area, combined with an increase in the number of Canadian passengers using the airport.

The low forecast for Burlington was computed by capping growth at the growth rate projected for the regional economy. The resulting low forecast has an average annual growth rate of 0.6 percent.

4.3 Summary

The base and alternate (i.e., high and low) activity projections are summarized in Table 4.7. The table lists estimated activity for FY 1993 as well as high and low forecasts for FY 2000. Average annual growth rates for both scenarios are also shown.

Tables

Table 4.1 New England General Aviation Operations at Non-Towered Airports (Average Annual Growth Rates through 2000)

	Connecticut	Massachusetts	Maine	New Hampshire	Rhode Island	Vermont	Total
Rate	0.9%	1.0%	1.3%	2.1%	0.8%	2.2%	1.2%

Source: FAA, Terminal Area Forecasts, July 1993.

Table 4.2 PFC Applications Approved in New England To Date

Airport	Date Approved	Duration (Years)	Total Approved Revenues
Bradley	July 9, 1993	2	$ 12,030,000
Logan	August 24, 1993	18	598,800,00
Manchester	October 13, 1992	4	5,461,000
New Haven	September 10, 1993	5	2,490,450
Portland	October 29, 1993	7	12,233,751
Providence	November 30, 1993	20	103,885,286
Worcester	July 28, 1992	5	2,301,382
Total			**$198,281,869**

Source: Airports, January 25, 1994.

Table 4.3 Air Carrier and Commuter Enplanements (000) New England Airports – FY 1978-1985

Airport	1978	1979	1980	1981	1982	1983	1984	1985
Bradley	1,456	1,653	1,531	1,401	1,234	1,440	1,583	1,747
Logan	6,690	7,558	7,651	7,391	7,935	8,617	9,305	10,343
Worcester	30	38	28	16	9	10	26	19
Bangor	Missing	Missing	164	151	127	134	177	213
Portland	254	286	282	249	238	306	475	505
Manchester	55	67	58	40	36	38	51	62
Pease	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Providence	497	522	526	477	362	377	471	617
Burlington	187	216	207	183	178	374	454	443

Source: FAA, HTA, individual airports.

Table 4.4 Air Carrier and Commuter Enplanements (000) New England Airports – FY 1986-1993

Airport	1986	1987	1988	1989	1990	1991	1992	1993
Bradley	1,999	2,328	2,465	2,422	2,475	2,232	2,327	2,387
Logan	10,628	11,543	11,832	11,088	11,085	10,339	10,974	11,391
Worcester	52	105	172	178	150	114	109	96
Bangor	215	214	281	836	694	1,149	1,033	886
Portland	604	617	690	504	571	551	608	597
Manchester	94	165	247	328	379	405	420	444
Pease	N/A	N/A	N/A	N/A	N/A	N/A	N/A	40
Providence	805	985	1,104	1,107	1,217	1,108	1,156	1,159
Burlington	437	464	467	448	425	402	422	432

Source: FAA, HTA, individual airports.

Table 4.5 Bangor International Airport Enplanement Projections: Distribution Between International and Domestic Enplanements

Enplanements	FY 1993	High Forecast	Low Forecast	Average Annual Growth	
				High	Low
Domestic	354,401	1,181,921	369,921	18.8%	0.6%
International	531,601	754,079	553,928	5.1%	0.6%
Total	886,002	1,936,000	923,214	11.8%	0.6%

Source: HTA.

Table 4.6 Pease International Tradeport Annual Airport Enplanements Projection – 2000

Aircraft Type	Share	Operations	Aircraft Size	Load Factor	Enplanements
BAe 146	20.0%	5,300	82	60%	130,380
SF340	40.0%	10,600	35	60%	111,300
BE1900	40.0%	10,600	19	60%	60,420
Total	100.0%	26,500			302,100

Sources: Pease AFB Comprehensive Redevelopment Plan and HTA.

Table 4.7 Forecast Summary – Enplanements (000)

Airport	FY 1993	High Forecast	Low Forecast	Average Annual Growth High	Average Annual Growth Low
Bradley	2,387	3,238	2,488	4.4%	0.6%
Logan	11,391	15,007	11,539	4.0%	0.2%
Worcester	96	152	100	6.8%	0.6%
Bangor	886	1,936	923	11.8%	0.6%
Portland	597	825	612	4.7%	0.4%
Manchester	444	623	463	5.0%	0.6%
Pease	40	302	42	33.5%	0.6%
Providence	1,159	1,401	1,187	2.7%	0.3%
Burlington	432	660	450	6.3%	0.6%

Source: HTA.

Figures

Figure 4.1 Bradley Total Annual Enplanements

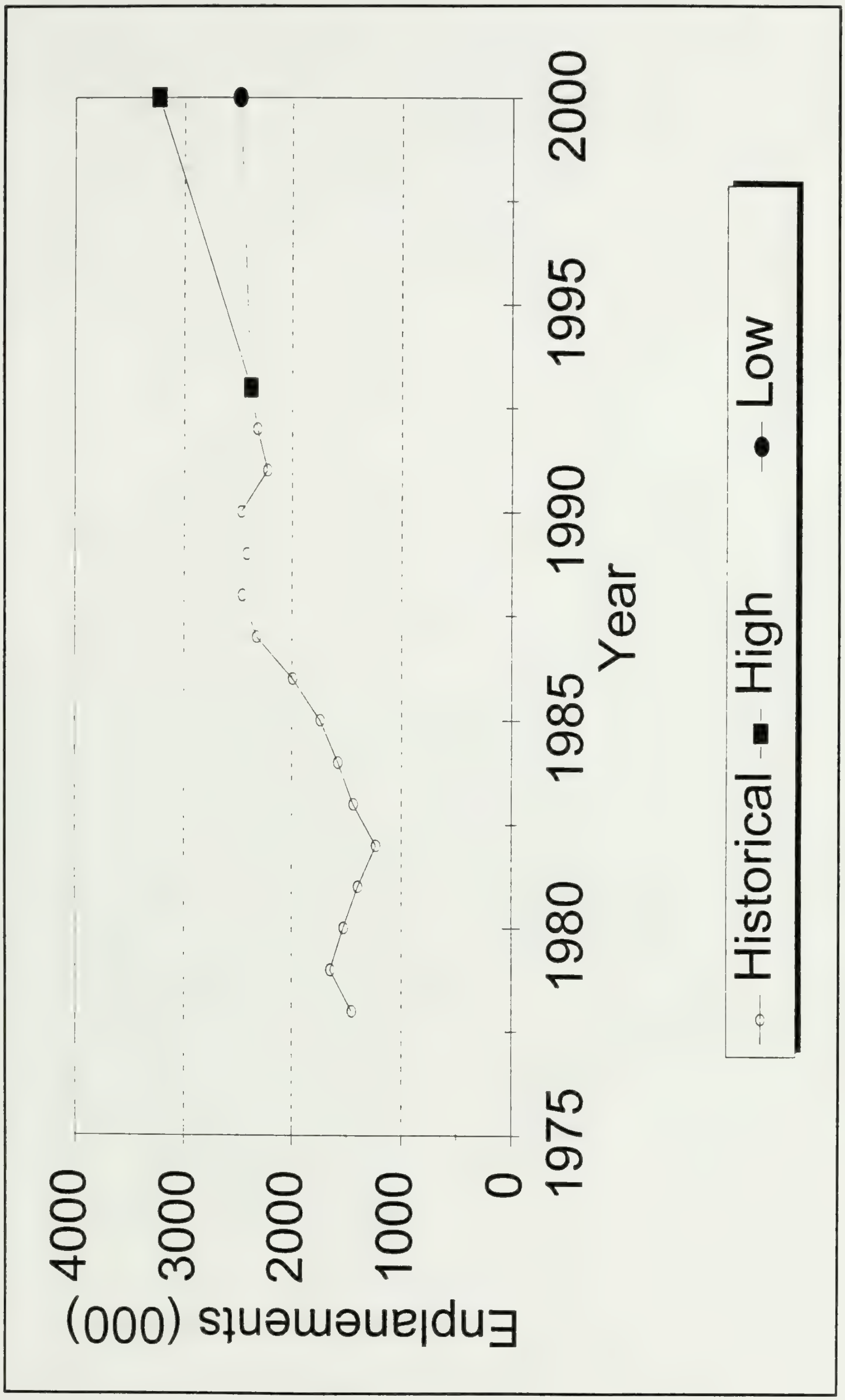


Figure 4.2 Logan Total Annual Enplanements

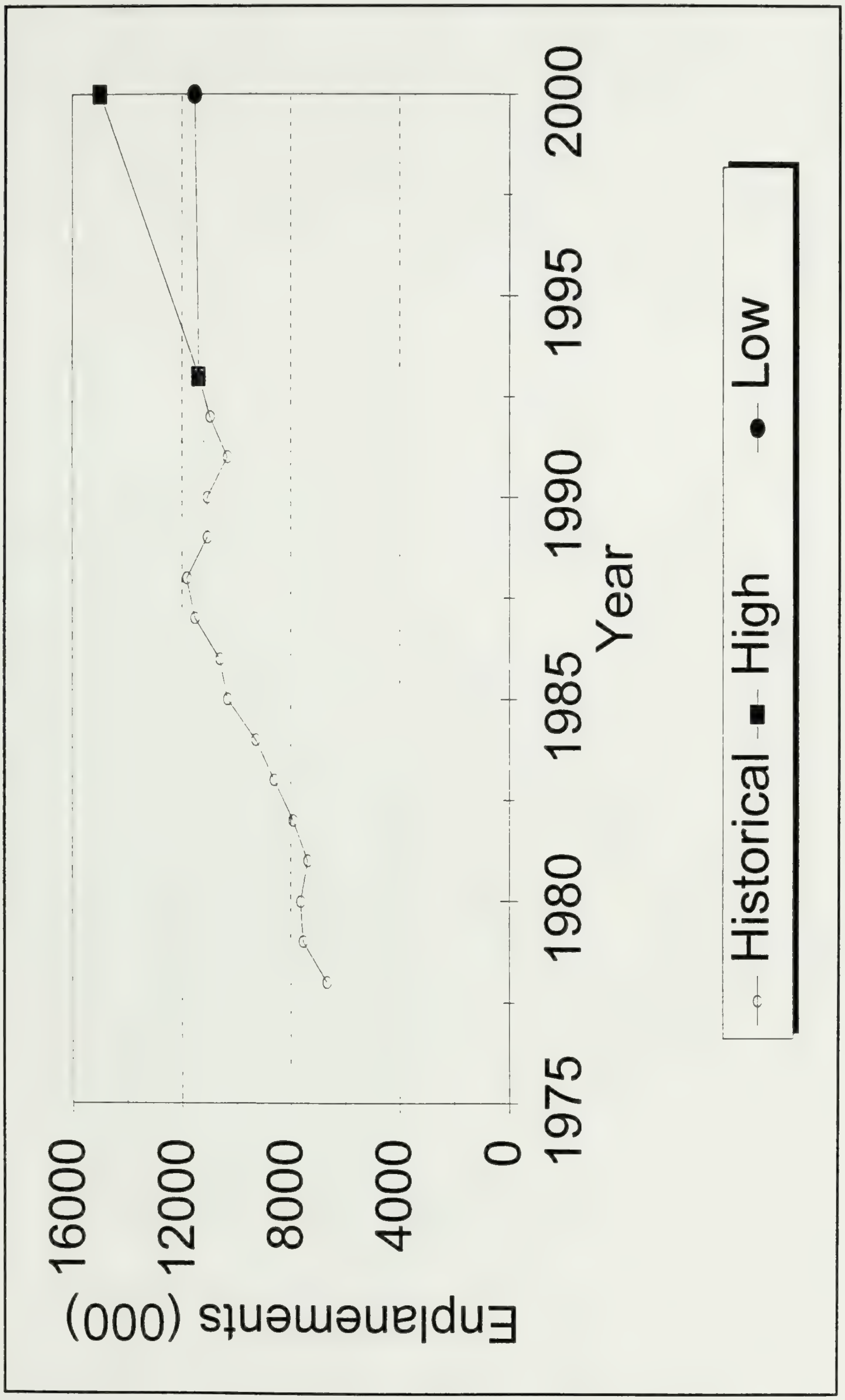


Figure 4.3 Worcester Total Annual Enplanements

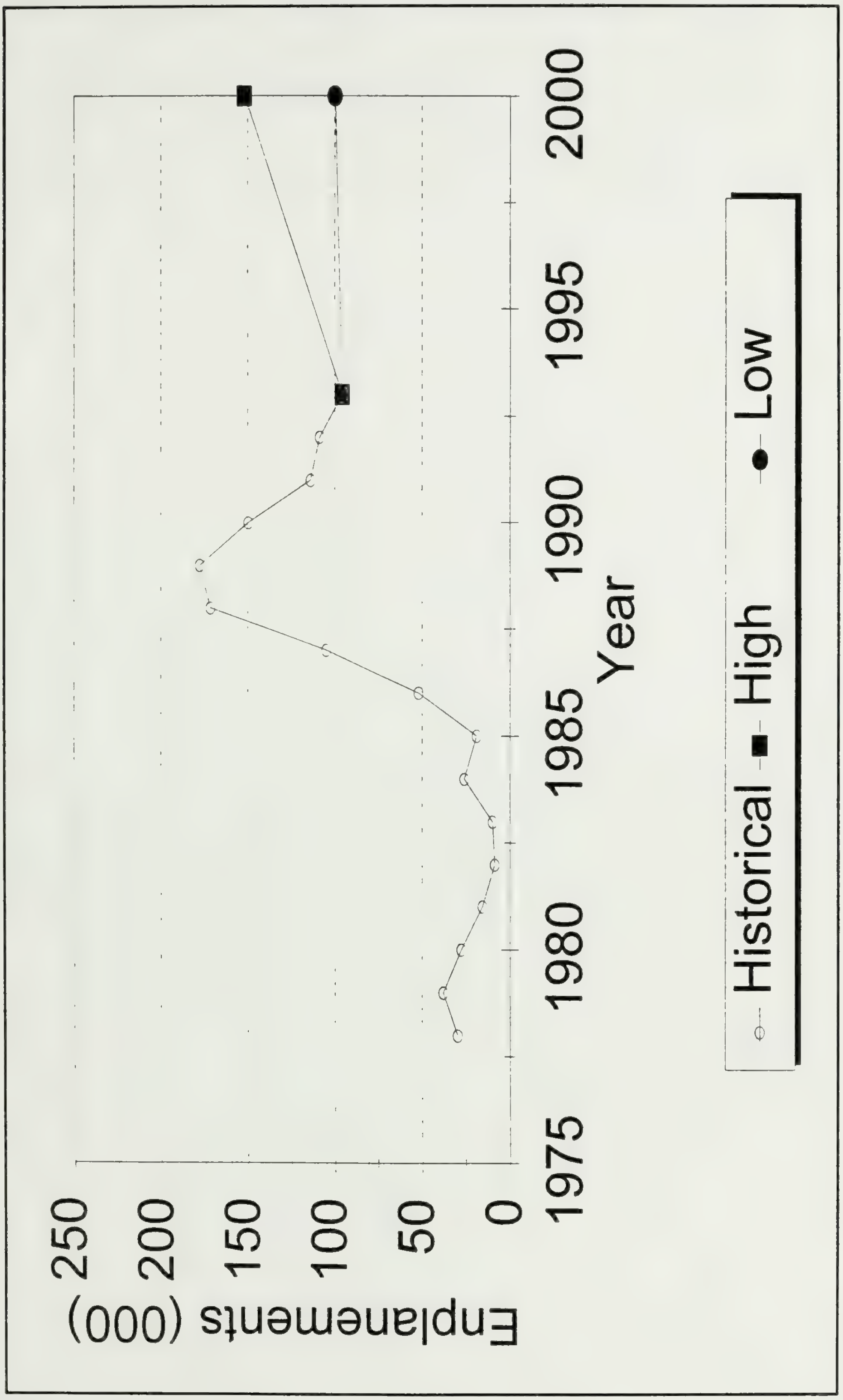


Figure 4.4 Bangor Total Annual Enplanements

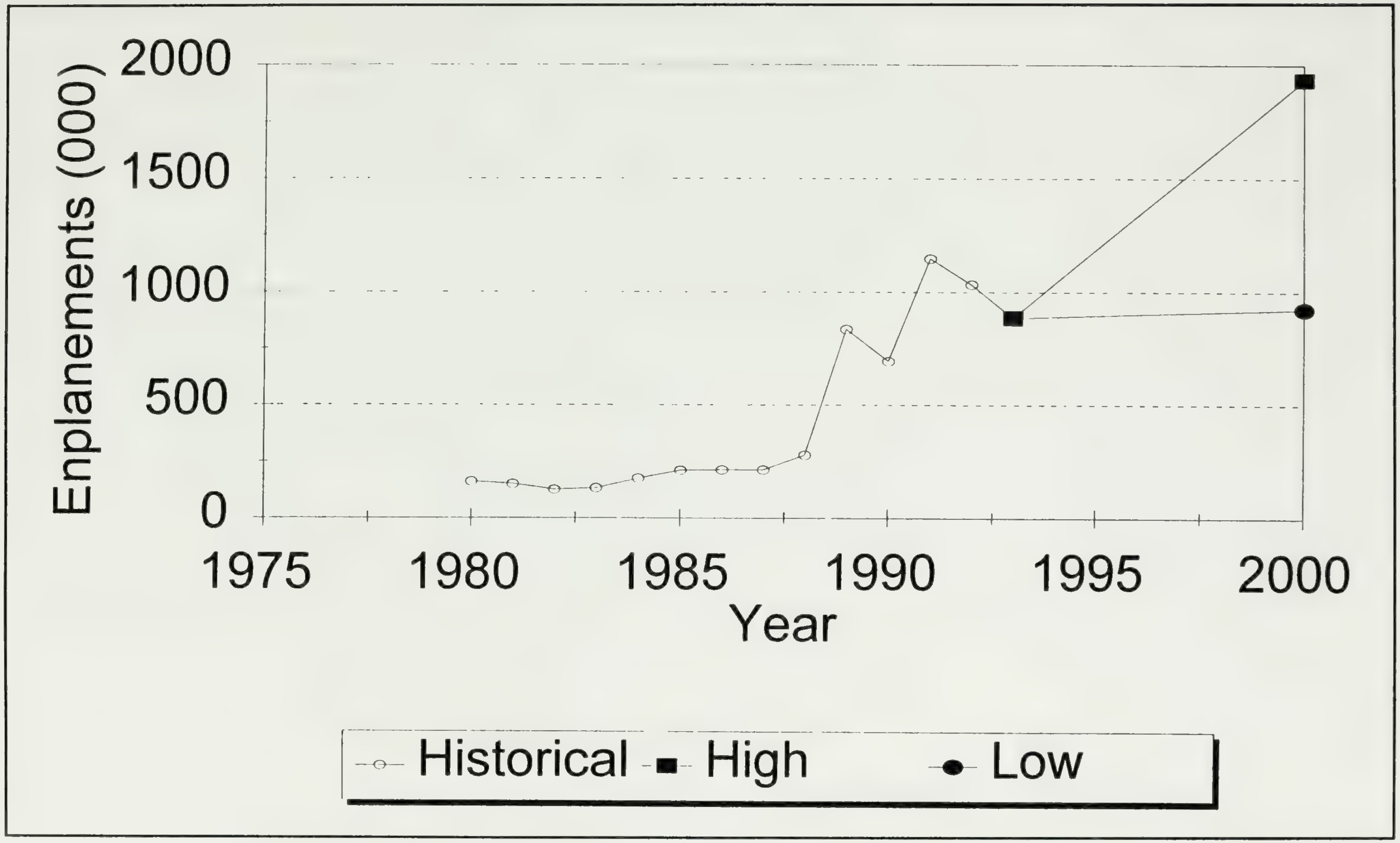


Figure 4.5 Portland Total Annual Enplanements

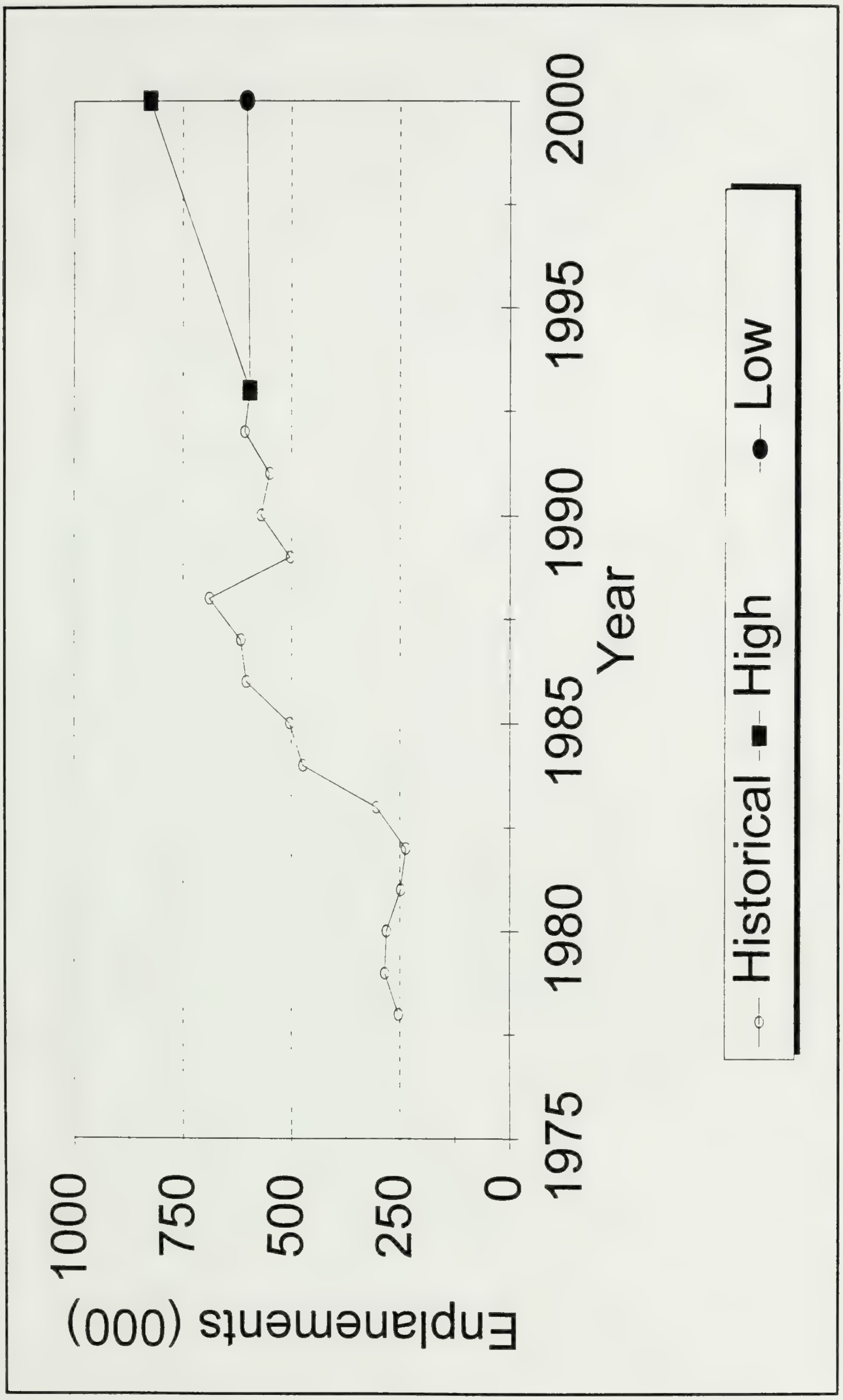


Figure 4.6 Manchester Total Annual Enplanements

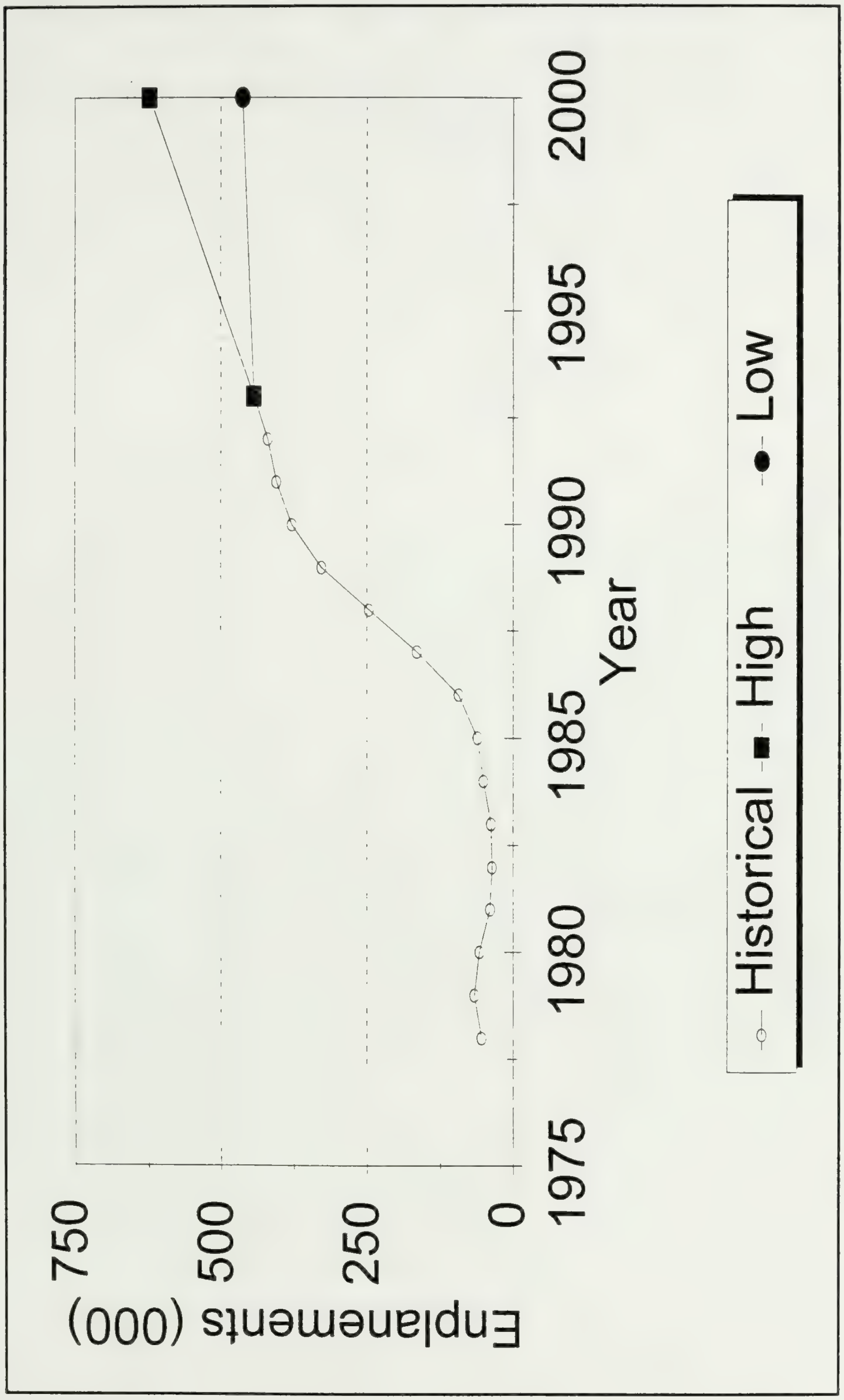


Figure 4.7 Pease Total Annual Enplanements

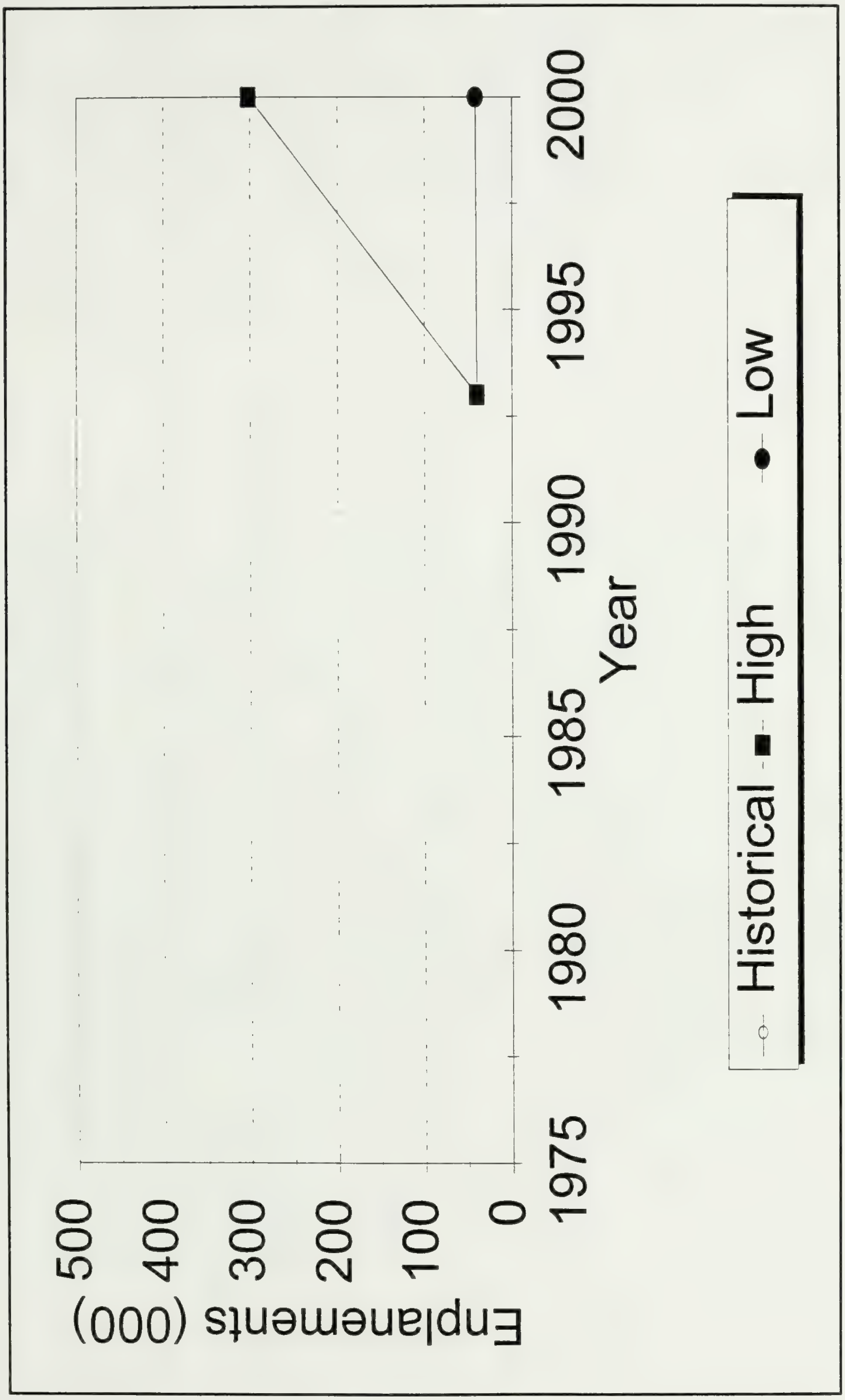


Figure 4.8 Providence Total Annual Enplanements

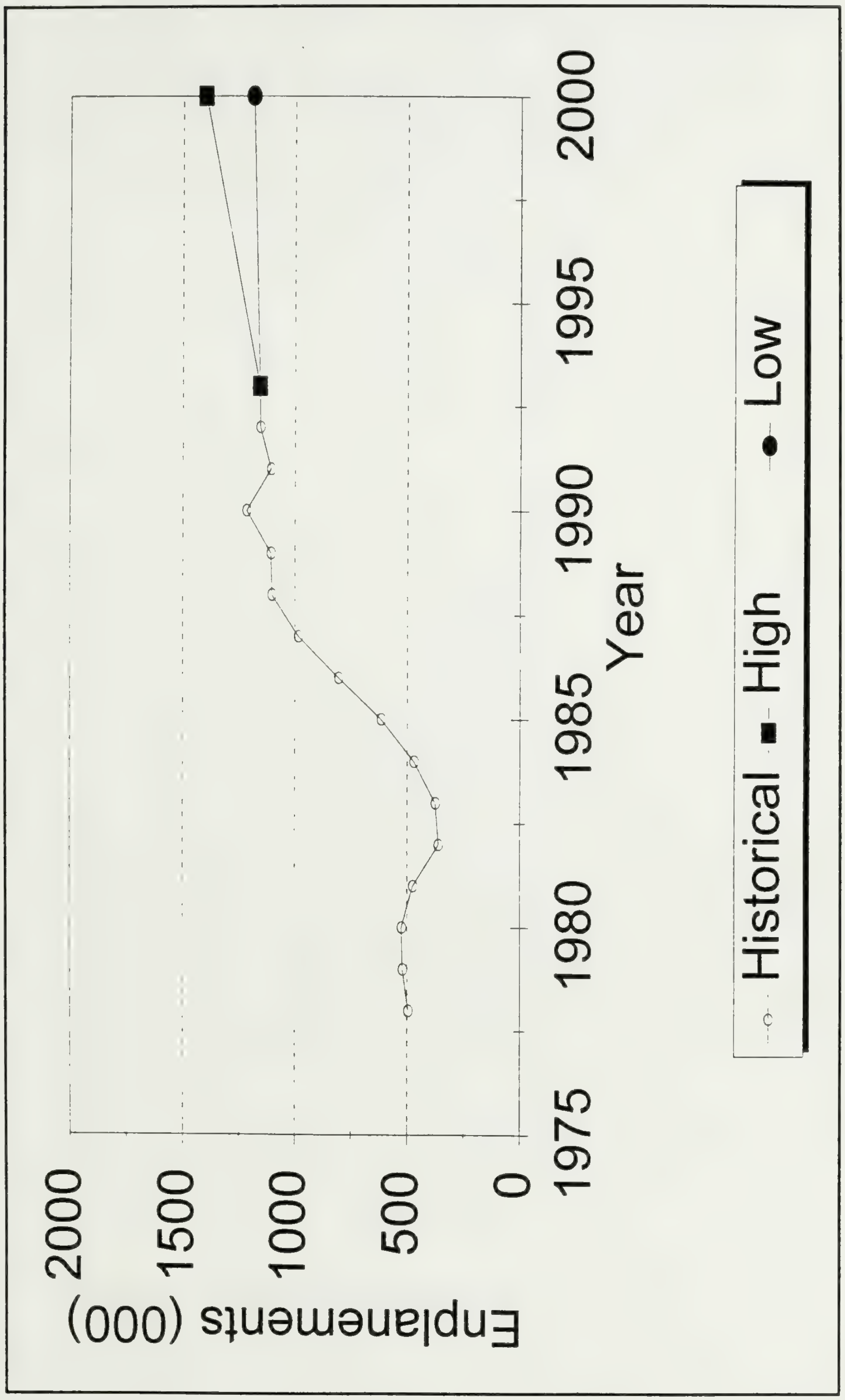
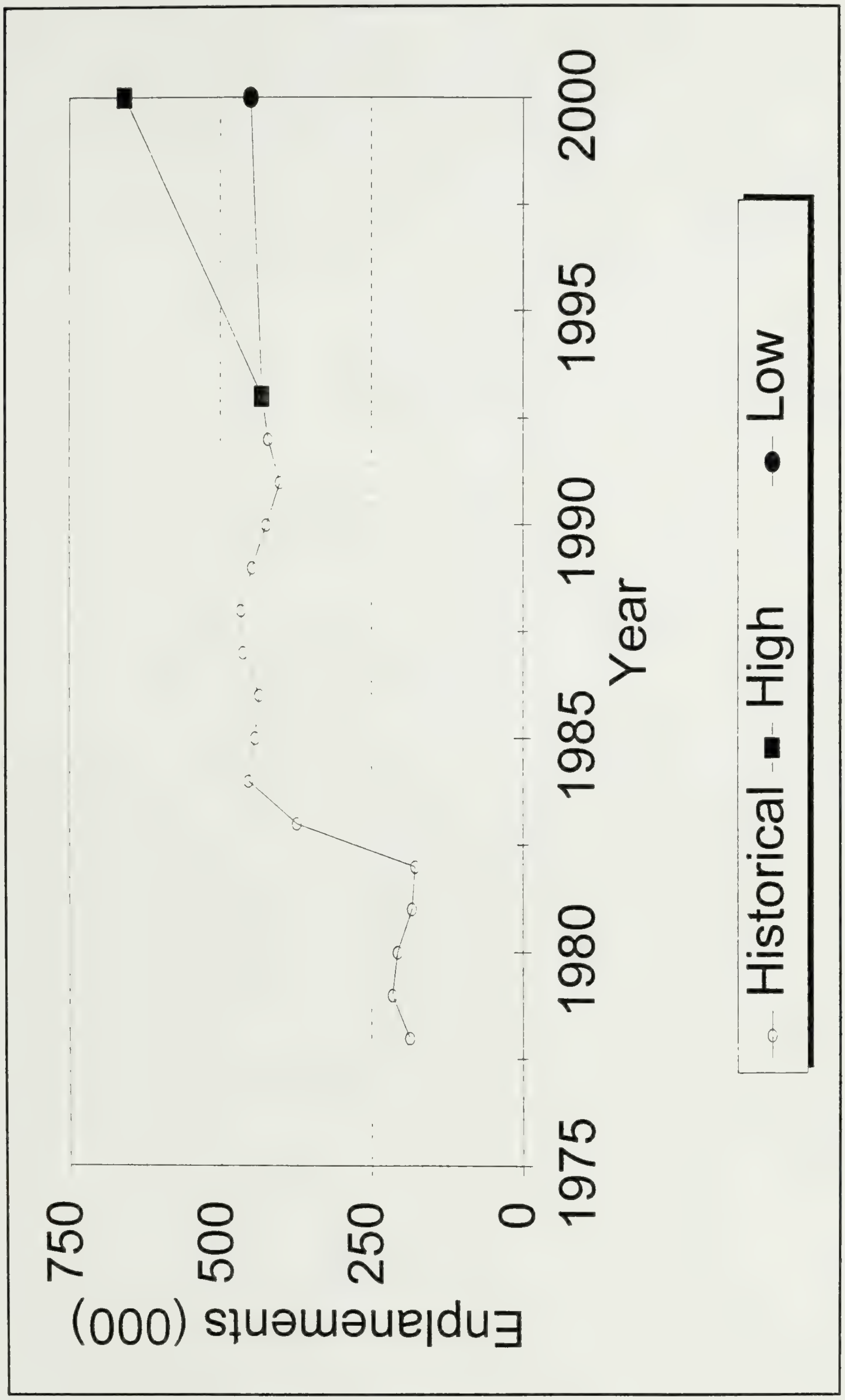


Figure 4.9 Burlington Total Annual Enplanements



5.0 Ports

5.0 Ports

The purpose of NETI, in the case of ports, is to guide public officials in the New England states as they decide at what level, and in what manner, to make investments in maritime facilities which serve cargo and passenger traffic. In order to make such decisions, estimates of the potential markets which may be expected to utilize the ports must be made. These estimates must address both the types and volumes of traffic which will exist in the future, in order to be of use in formulating an implementation strategy for long-term growth, if such growth is, in fact, legitimately expected.

The ports of New England have traditionally played an important role in the movement of goods between international origination points, and the domestic market area, or "hinterland." The ports also provide access to international markets for businesses and manufacturers which exist in the local New England area. The ports of New England have also played a varying role throughout the years in serving the hinterland which extends beyond the New England region, particularly the upper Midwest, due to the orientation of the region's railroad and highway connections.

Forecasting of future traffic through a particular region or port must take into account both the general rise and fall of commodity shipments due to global economic forces beyond the control of local authorities; and the competitive factors which, given a particular level of commodity traffic, cause one port or region to be considered more attractive to shippers than another.

The approach of this section, therefore, is to:

1. Identify the major commodities shipped through the New England ports (on a region-wide basis, rather than port-by-port) and the recent (three-year) trend in the volumes handled.

2. Discuss recent trends and projected future growth in these major commodities based on general economic trends (again on a New England-wide basis); and note any marked trends that a specific port has been experiencing vis-a-vis each commodity and the finite number of industrial waterfront acres.

3. Describe in general terms how the individual ports of New England are already planning for growth, and how they are realistically positioned to capture various market segments.

5.1 Commodities Handled and Recent Trends – Imports and Domestic Receipts

The major commodity moving through New England's ports, on a total tonnage basis, are liquid and dry bulk fossil fuel products such as petroleum (gasoline, diesel, heating oil, etc.) and coal. As illustrated on Figure 5.1, the combination of these products totaled slightly over 90 percent of the entire tonnage of commodities received at the ports studied in the years 1989-1991. These products are either consumed directly at the receiving port, for example in a waterfront power plant; transferred to trucks for distribution to local gasoline or heating oil distributors; transported by truck or rail to points further inland; barged to other, smaller ports; or transported by one of three major pipeline systems which connect New England ports with interior, or Canadian points.

If these liquid and dry bulk fuel products are subtracted from the New England import total, a commodity mix as illustrated in Figure 5.2 is the result. As is seen in this figure, the largest "non-fuel" category received in New England was non-metallic minerals consisting largely of items such as crude gypsum and plaster; salt; and sand, gravel and crushed rock; with the next largest single receipt at New England ports consisting of building cement.

Other significant non-fuel items received in New England are iron and steel products, such as structural plates and sheets; basic chemicals, such as sodium hydroxide, various alcohols, and fertilizers; food products (prepared foods, alcoholic beverages, cooking oils, dairy items); agricultural products (fresh and frozen fruit and vegetables); motor vehicles including related parts and equipment; lumber, wood and furniture; pulp and paper-related cargoes; and miscellaneous machinery and manufactured products. The latter category represents goods which are generally containerized for shipping, when moved in any significant volume.

Figures 5.3 and 5.4 illustrate the trends in total tonnage received in the various cargo categories for the years 1989-1991, which represent the most recent years for which complete data is available. (The Appendix at the end of the chapter includes similar data on a port-by-port basis.) The tonnages shown are the aggregate total for 11 of the 12 ports studied. (Additional data for Davisville, Rhode Island is currently being obtained from the Rhode Island Port Authority.) An analysis of these trends and implications on future growth is presented later in this chapter.

5.2 Commodities Handled and Recent Trends – Exports and Domestic Shipments

Figure 5.5 illustrates the mix of commodities that are shipped out of the New England ports studied, either for overseas destinations, or to other ports via coastwise movement. (It should be noted that these coastwise shipments often terminate at other New England

ports, which may result in a single movement of a commodity being counted as both a New England "shipment" and a "receipt.") Again, the petroleum product sector forms the major single product that is transported out of New England ports, accounting for about one-half of all outgoing shipments.

If the petroleum products are subtracted from the export total, the resultant product mix is as illustrated in Figure 5.6. By far the predominant "export" of New England is scrap iron and steel, followed by pulp, paper and allied products, and, increasingly, a variety of miscellaneous manufactured products.

Other export commodities included miscellaneous chemicals and fertilizers (much of which was domestic coastwise shipments, as discussed above); prepared food, agricultural and seafood products; non-metallic minerals (again, domestic coastwise shipments of sand and gravel, etc.); finished and raw lumber and wood (including furniture); and paper waste and scrap.

Figure 5.7 illustrates the trends in total tonnage shipped in the various non-fuel cargo categories for the years 1989-1991, which represent the most recent years for which complete data is available. (The Appendix contains similar data, broken down on a port-by-port basis.)

5.3 Analysis of Trends and Implications on Future Growth

This section attempts to provide a qualitative analysis of recent commodity trends in New England shipping, and to forecast what the future holds in terms of growth (or shrinkage) in the various sectors. It is first necessary, however, to understand some of the basic factors which will come into play.

5.3.1 Factors Which Will Impact Growth Trends

Future growth in the export or import of any of the commodities discussed thus far will be a result of many factors. Some of these are external factors, which cannot readily be affected one way or another by actions at the local, state or regional level. These factors include the overall state of the domestic and international economies; population and demographic shifts; international agreements and treaties which have explicit impacts on the balance of trade between countries with regard to certain types of products and raw materials; unforeseen political upheavals; and changing attitudes about the environment and the use of certain raw materials in the manufacture of goods.

Internal factors are those which can, to some extent, be affected at the local level, through shifts in funding priorities, and management and operations policies. These internal factors, which determine the competitive balance among ports both within and outside of

the New England region itself, include the availability and maintenance of up-to-date physical facilities; fees, taxes and charges to port users; efficiency, reliability and cost of labor; flexibility of scheduling; presence and efficiency of intermodal connections; particularly in the ability to provide land-side connections to national markets; availability of related maritime services; local attitude toward the maritime industry and waterfront policy; and the actions of competing ports.

Finally, there are a number of immutable factors, which cannot be changed for a particular location, such as proximity of a port to foreign and domestic shippers and industries; weather conditions; and proximity to necessary raw materials. The effect that these unchangeables actually have on growth (or decline) of a port depends to a large extent on a combination of the external and internal factors discussed above.

5.3.2 Forecast for Non-Competitive Cargo

In New England, most of the tonnage handled consists of bulk cargoes (such as oil, gravel, coal, etc.) or neo-bulk cargoes (such as iron and steel products). These commodities typically are handled at private terminals within each port, and are assumed to be consumed directly in the port's local hinterland. In other words, each port receives what it needs locally in each commodity category, and there is little or no competition between ports for a share of the overall volume. The external factors described above will cause volumes to ebb and flow along with general economic conditions, but there is little need for ports to make internal-type improvements in order to remain competitive. These cargoes may be defined, therefore, as "non-competitive."

Liquid and Dry Bulk Fossil Fuel Products

Commodities in this sector, including oil, gasoline, and coal, are expected to experience a decrease of between five percent and 10 percent over the next 15 years. This is largely due to the need to decrease air pollution in the region, which is in non-attainment of Federal EPA Clean Air standards in many locations at present. The growth in population in New England during this period of time is actually expected to involve an <u>increase</u> in total energy consumption in the region, but the portion of energy market share that petroleum products will control will suffer a net decrease due to increasing reliance on natural gas and other cleaner-burning fuels, and the promotion of more fuel-efficient modes of transportation.

Non-Metallic Minerals, Building Cement, and Iron and Steel Products

These commodities consist largely of gypsum and plaster materials; salt; crushed stone, gravel and sand; and heavy structural metal shapes. These commodities typically are associated with construction activities such as homebuilding and heavy construction for such facilities as roads, bridges, large commercial buildings and other concrete and steel structures. The recent trend in this group indicates a peak during the year 1990, which coincides with the end of the construction boom in New England. The volume of these products will remain very much tied to the fortunes of New England's construction

industry, which is presently expected to trend negligibly upward at an approximate rate of 0.2 percent per year (The New England Power Planning Group, 1993).

Basic Chemicals

The importation of basic chemical products used in industrial and manufacturing processes has remained more or less stable for the period studied. This sector is therefore expected to grow at the same average rate as the local economy, or approximately 0.5 to 1.5 percent per year.

Iron and Steel Scrap

This commodity represents the major cargo in the New England export market. In 1989, this cargo accounted for over 3/4 of the total non-fuel export tonnage at the ports studied, declining to approximately 2/3 of the total in 1991. In absolute terms, however, the tonnage of this item handled on a yearly basis has been relatively stable. It is projected therefore, that this commodity will follow the general New England growth rate of 0.5 to 1.5 percent per year on average.

5.3.3 Forecast for General Cargo

It is in the "general cargo" category, including such items as food and agricultural products, motor vehicles, lumber, wood and furniture, pulp and paper, and miscellaneous manufactured products, that the ports of New England can be considered in competition with other East Coast ports, and to a lesser extent, with each other. Thus, the forecasting of volumes in these categories becomes more difficult, as it is based not only on general economic trends which affect the demand for the importation of the commodities themselves, but also on the competitive balance between the New England ports and other competing ports. For the most part in New England, port marketing studies, where they have been done, have focused on capturing volumes from other New England ports. Little or no quantitative analysis has been done in order to study the potential gain (or loss) of traffic of New England ports in general, versus other East Coast ports, given the major shifts now ongoing in the shipping and land transportation industries (i.e., increased containerization and consolidation).

Due to this lack of specific marketing analysis for New England as a whole versus other Eastern seaboard locations, therefore, the forecasting of volumes in these commodities can only be addressed in general terms.

Containerized Cargo

A number of general commodities handled at New England ports are containerized at present, and the general outlook nationally is for increased containerization as shipping lines, railroads and trucking companies forge new alliances in order to promote a more seamless system of goods transport. Typical containerized commodities include miscellaneous manufactured products and consumer goods; agricultural and food items, processed fish products; wood and furniture products; and some lumber and paper products.

- **Miscellaneous Products** – Shipments of miscellaneous manufactured products, including high-value items such as computer parts, have represented one of New England's encouraging growth markets during the 1989-1991 period. During this time, exports of miscellaneous products jumped from 0.9 percent to 13.5 percent of the overall export mix, and from 0.3 percent to 7.9 percent of imports. (It should be noted that absolute volumes of this commodity were down, mirroring the trend in the overall economy, but the decline has been much less than in the other products studied).

- **Agricultural and Food Products** – This market segment, which includes fresh fruits, and imported foods from Europe and the Far East is the only major cargo which has actually shown steady growth, in absolute terms, throughout the 1989-1991 time period. As the decade progresses, it is anticipated that food products will continue to form an ever greater portion of the New England commodity mix.

- **Furniture** – Furniture is another growing commodity in New England, largely handled in containers. Imports are expected to rise as several large importers have plans to bring in several hundred containers per year into their national distribution system, via New England.

- **Fish and Fish Products** – Fish can be both containerized and handled conventionally, and represents another growth cargo for New England. Fish have grown as an export, but more significantly as an import, providing over two percent of the overall commodity mix in 1991.

Automobiles

The general trend for the importation of autos into New England ports has been downward, with this item declining from 2.4 percent of all imports in 1989 to 1.5 percent in 1991. Exports have been negligible. Part of the reason for this is the recent trend in the auto industry to consolidate shipping at as few ports as possible. By using a single load center on each coast, savings are realized through economies of scale, and the present trend on the Eastern seaboard has been toward mid-Atlantic ports such as Baltimore and Wilmington, Delaware, which have tri-level and double stack container rail capabilities. New England ports, including Davisville, could compete in this market if the same rail capabilities were available.

Forest Products and Paper Products

The forest product industry in New England has been cited as one of the fastest growing export businesses (presently representing about 10 percent of exports). The U.S. is the second largest producer of forest products in the world, behind Canada. The U.S. industry is one of the world's lowest cost producers of forest products, and these raw material and processing cost advantages, along with the devalued dollar, have allowed domestic producers to remain very competitive in the international marketplace. Because of restrictions put on logging on Federal lands in the Pacific Northwest, which have created great difficulties in the logging and paper industries, attention has shifted to the great preponderance of privately owner timber lands in New England to pick up the slack. This, of course, raises environmental issues for New England. The actual growth in forest

products exports will be tied primarily to levels of construction overseas, and the trend appears to be positive at present. The U.S. Forest Service has predicted annual growth rates of 2.8 percent in woodchips; 3.1 percent in woodpulp; 4.1 percent in newsprint paper; and 2.5 percent in softwood lumber.

5.4 Effects on Individual New England Ports

The discussions presented to this point have focused primarily on trends and forecasts related to New England as a whole. How the individual ports will perform will depend, again, on a number of factors. Assuming the percentage of overall growth to be very low (or even negative in some instances), what can the individual ports expect to encounter during the next decade? In addition, as many of the ports seem to be making improvements based on narrowly focused projections, do they run the risk of cannibalizing each other's markets? Within the New England market, there may be said to exist a two-tiered system to the ports.

- **General Cargo Ports** – Portland, Portsmouth, Boston, Providence and Davisville. General cargo ports have the potential to handle all major commodity types which are containers, drybulk, neobulk, and liquid bulk. With the exception of Providence, all of these ports are presently, or have in the recent past, undertaken improvement programs with the goal of capturing some of each other's market. (Providence, although having handled containers in the past, appears to be withdrawing from both the general cargo and automobile markets, with much of this traffic being proposed for the more developable Davisville port instead. For the remainder of this section, Davisville will be assumed to replace Providence as the most likely candidate for modernized general cargo and automobile shipping in Rhode Island.)

- **Niche Ports** – Searsport, Eastport, New Bedford, Fall River, Bridgeport, New London, New Haven, and Bridgeport. These ports tend to service a very specific hinterland, specialize in a limited mix of commodities and (with the exception of Searsport) do not offer, or plan to offer, container service.

Figure 5.8 illustrates the relative amount of traffic at each port, and divides imports from exports. Figures 5.9 and 5.10 illustrate which commodities (excluding bulk fuels) are typically imported and exported at each of the studied New England ports. It should be noted the percentages shown on the figures represent the proportion of each port's non-fuel market that a particular commodity represents, and does not account for the relative size differences between each port (i.e., a 50 percent figure at a port such as Fall River represents a much smaller number, in absolute terms, than a five percent figure in Boston.)

5.4.1 Competition Between New England's General Cargo Ports

General Competitive Factors

Maritime industry experts agree that the future success of general cargo ports will depend on the ability of a port to effectively integrate rail transport and shipping. The perceived benefit of establishing an effective intermodal container port in New England is that it would allow Midwestern industries, including steel fabricators, the auto industry, chemical industry, etc. to have a year-round, ice-free port on the East Coast which avoids the New York area's longer shipping distance to Europe. Much of this traffic presently moves via the St. Lawrence Seaway, which has typical transit times of one to two weeks and is closed because of ice for approximately four months per year. Such a port could also, in theory, compete with other East Coast ports for the increasing volume of "mini-land-bridge" traffic which moves by rail between Pacific and Atlantic ports.

Thus, the existing New England ports which aspire to establish intermodal container service, (Portland, Portsmouth, Boston, and Davisville), are in effect competing against each other for Midwestern traffic which could bypass the St. Lawrence Seaway, and against other eastern seaboard ports, such as New York/New Jersey, for mini-land-bridge traffic.

The competitiveness of a particular port, in either case, depends on several factors, all of which relate to the cost of the commodity being shipped. The importance of one factor over another depends on the nature of the products, and who bears the primary shipping costs, both direct and indirect. Direct costs include dockage and wharfage fees paid to the ports, handling costs paid to stevedores, intermodal transport costs to move the products between the port and the users, and the actual ocean shipping rates paid to the shipping lines.

Indirect costs include the handling costs incurred while a shipment is in transit, and the cost of time spent waiting for a berth, being loaded/unloaded, or sitting on the dock waiting to be picked up. Indirect costs are often much larger than the direct handling costs.

The differences in direct costs between ports, whether based on freight rates or union/non-union labor rates, tends to be small when compared to the indirect costs which are impacted by time. Thus, ports compete not only on price, but also on convenience, or service. Savings in direct port charges at a "cheaper" port can be totally negated if a shipment is late, if capacity constraints cause scheduling inflexibility, or if additional intermodal trucking or rail costs are incurred because of the distance from the "cheaper" port to the market. In addition, shipping rates themselves are often lower at the ports which are perceived as "expensive" because this is where the larger volumes are found. Larger volumes often means the presence of competition between several shipping lines, whereas the smaller "inexpensive" ports are often served by feeder services of one particular line, serving one particular destination (for example northern Europe only, and not the Far East.) This competition can translate into lower shipping rates which more than offset the other cost advantages of smaller ports.

Competition for Container Traffic

Common-carrier shipping services offer the ability to handle a wider range of containers and destinations (especially for imports from the Far East) than do feeder services tied to a particular shipping line and or destination. Also, establishing less-than-container load (LCL or "consolidation") services can be a useful way to increase container business at smaller ports that lack sufficient volume for full containerload traffic.

Boston continues to encourage growth of container cargos with its two terminals handling the bulk of New England's containerized cargos. Currently, however, both Davisville and Boston are promoting the implementation of double stack rail service (serving the interior U.S. via Worcester, Mass.) in order to make them the premier container ports. If they both are successful in gaining double-stack service, they can hope to halve most of the common carrier container traffic. (In any event, Portland would most likely retain its container feeder service due to it's favorable labor practices and unique ability to service northern New England and Canada.)

At present, however, the double stack rail service volume has yet to be determined. Both Davisville and Boston have connection to the Worcester intermodal freight facility, and will be in competition by providing better and cheaper service. (Portsmouth has already seen its feeder service shifted to Portland, due to scheduling difficulties and limited physical facilities, which proves there is a limited amount of containerized traffic to be had.)

Competition for Automobile Traffic

Another area in which New England ports hope to compete with other East Coast ports is for the import of automobiles. The current trend in this business is for the auto companies to seek only a limited number of ports on each coast to serve as load centers for their product. Sufficient space, competitive port costs, access to markets and access by tri-level auto-rack railcars are all important factors in choosing a load center. Motor vehicle importers also require either directly on-site, or nearby, facilities for vehicle preparation and accessorizing prior to distribution of autos to dealerships. In addition, large roll-on roll-off ships now handle the bulk of the auto shipping traffic, requiring specialized pier facilities.

In New England, 44 percent of automobile imports are through Davisville and 42 percent are delivered to Boston. Neither location is presently accessible to tri-level auto carriers, however, and during 1993 two auto manufacturers pulled out of Davisville for this reason, in favor of mid-Atlantic ports.

As Boston's valuable waterfront land becomes unavailable due to development, or is pre-empted by the Central Artery construction project, Davisville has emphasized its superior storage facilities, with access to some 550 acres of open storage and accessibility to major markets. Tri-level access to the port depends upon a clearance enhancement project. The environmental studies for alternate track configuration and improved vertical clearance by the State of Rhode Island are underway, with a final design of the preferred alternative to begin in 1995.

5.4.2 Overview of Recent Marketing Activities at General Cargo Ports

Several of the cargo ports studied have undertaken marketing analyses of their own in recent years. Although such analyses from competing ports can easily be contradictory as far as trying to develop region-wide forecasts, they nonetheless are useful in determining what each location feels its strengths and weaknesses are. In the following summaries of the existing marketing analyses, detailed discussions of technical short-comings and planned improvements are purposely omitted. These improvements will instead be addressed in the subsequent phase of NETI which deals with Operational Analysis.

In addition, for detailed information on existing facilities, the reader is directed to the NETI Inventory Report.

Portland, Maine

The port presently offers a full range of marine facilities and services including Merrill Terminal, a major dry cargo facility which is privately owned and operated; the publicly-owned International Marine Terminal from where Prince of Fundy cruise ships to Nova Scotia operate and the Portland Fish Pier Complex consisting of two major piers including the Fishing Boat Service Pier and the Fish Auction Pier.

Cargo Traffic

In Early 1991, the firm of Hapag-Lloyd America, Inc., announced it would drop Portsmouth, New Hampshire and add Portland to its container feeder service. Their container ship arrives in Portland on a weekly basis after first being loaded in New York with containers arriving in larger ships from Europe and the Pacific Basin. The ship serves Portland and Boston and returns to Halifax, where containers loaded in Portland and Boston are transferred to larger ships headed to Europe. The goal of Hapag-Lloyd is to load and unload 50 containers at Portland on a weekly basis which will generate approximately 57,000 tons of cargo annually. This has been achieved. Since August of 1991, the volume of cargo has averaged 40 containers per week. In October of 1991, Hapag-Lloyd announced that Portland would be a permanent stop on its North Atlantic cargo route. The establishment of the container cargo feeder service provides Maine businesses improved accessibility to international markets.

Passenger Traffic

The of City Portland as well as the state wish to encourage additional cruise traffic through the International Marine Terminal. Portland is the only port in Maine with a dedicated passenger terminal. Recent facilities improvements financed by Maine DOT represent positive steps in this regard. Fifteen cruise ships visited Portland in 1991.

Officials from Maine DOT and the City of Portland are continuing to review opportunities to expand the use of the terminal beyond the current cruise ship and containerport operations.

General Marketing Strategy

During the 1980s Maine developed a three-port development strategy which would target public investment for major port improvements at Eastport, Searsport, and Portland. As a result, these ports are becoming a more important part of Maine's economy. However, to realize the full potential of these facilities requires more public and private investments.

Maine's general objectives for its major ports, including Portland, are to:

1. Continue to adhere to the three port strategy for investment in cargo ports and preserve and enhance port access including interconnections with rail and highway facilities.

2. Base future cargo port investment on traffic growth, utilization levels, opportunities for interconnections with other modes of transportation, projected benefits to the Maine economy and environmental impacts.

3. Continue efforts aimed at maintaining, expanding and marketing container cargo service to Maine ports.

4. Continue to explore options for expanded use of the International Marine Terminal in Portland.

5. Monitor efforts to deal with the problem of processing of fish waste and evaluate whether any public investment in facilities is warranted to leverage private investment.

These objectives attempt to create a more comprehensive strategy for the major ports of the entire state. In this way niche ports can thrive with general cargo ports without worrying about cannibalization of each others markets. Infrastructure is used more efficiently, and capital investment can be more focused to general gain. The Maine planning approach would appear to be a useful model for other state and regional port planning agencies in New England to follow.

Portsmouth, New Hampshire

The port plays an important role in the movement of trade goods to and from the surrounding market area which includes the states of New Hampshire, Maine, Vermont and Massachusetts. The port recently obtained the necessary permits in order to begin a major refurbishment and expansion of the existing facilities.

Cargo Traffic

The 1987 marketing studies undertaken for the port expansion suggested that the port had strong expansion potential provided that certain operational problems were overcome. It was felt that all of the major commodities showing increased tonnage trends in New England (such as construction products, food, paper, motor vehicles, etc.) were connected to major employers and consumers in New Hampshire, as well as the rest of New England.

Realizing that Portsmouth could not compete with Boston for common carrier container traffic, the study further indicated that the port's greatest potential lay in neobulk

(breakbulk) cargoes such as lumber, steel products, scrap metal, paper, heavy machinery, vehicles, bricks and similar materials. The cumulative potential identified within those industries amounted to an additional 20-30 ships per year landing at the port.

Since the time of the 1987 study, Portsmouth did indeed lose its container feeder service due to operational and scheduling difficulties posed by the port's limited physical facilities. Given the satisfaction that has been expressed regarding operations and service at the non-union Merrill Terminal in Portland, it would appear doubtful that this service can be regained anytime in the near future, unless container volumes increase dramatically, thus justifying an additional stop at Portsmouth.

Boston, Massachusetts

General Marketing Strategy

Boston, due to its traditional role as the population, business and maritime center of New England, continues to be the dominant port in the region. While it continues to modernize the Moran and Conley container terminals, and is actively promoting the extension of double-stack container train service to the port, there does not appear to be any comprehensive marketing analysis planned at this time. The focus appears to be on putting into place those improvements which have been identified in the general port industry as "necessary," without any specific justification in terms of the increased volumes which might result, and from where these volumes would be diverted.

The port's obvious competition for East Coast (as opposed to New England) based traffic is the Port of New York and New Jersey. Massport officials have estimated that approximately six percent of the general cargo into Boston is destined for points outside of New England, and would very much like to increase this figure. This being the case, it would appear that a detailed study of Boston's present advantages and disadvantages versus New York/New Jersey and other ports would be in order, so as to develop a well-planned and sequenced set of improvements and marketing strategies. As more and more general cargo moves into containers (the current growth rate nationally for containerized cargo is over seven percent per year), Boston must begin to seriously strategize or risk spending money haphazardly.

Davisville, Rhode Island

Upon the Navy's pull out from its Davisville Construction Battalion Center, there will be 550 industrial acres for development of the Quonset Point/Davisville Industrial Park/Intermodal Transportation Center. The site is seen by Rhode Island officials as the key element in preserving and modernizing the state's industrial and manufacturing base. The project has the potential to link existing marine terminals and the airport to current rail freight service throughout New England via the Northeast Corridor, and the state has developed plans for improvements to all three modes serving the site.

Two interrelated rail improvements in particular are crucial for the port to realize its potential. The first is the addition of a third track to the Amtrak mainline between Davisville Junction and Boston Switch (the junction in Pawtucket where the freight line to Worcester diverges) in order to provide additional capacity for freight movements

associated with increased automobile container and bulk aggregate handling at the port. The changes proposed by Amtrak in the Northeast Corridor Improvement Project (NECIP) do not preclude the installation of a third track.

The second essential rail improvement is provision of increased vertical clearance between Davisville Junction and Boston Switch in order to accommodate tri-level auto carrier and double stack container trains, which are now considered industry standard. The environmental studies necessary for both the third track and improved vertical clearance have been initiated by Rhode Island, with a final design of the preferred alternative slated to begin in 1995.

Cargo Traffic

A 1993 document prepared in support of funding for the rail improvements identified three primary types of freight which could develop sufficient business to justify local improvements. These include automobile imports/exports, domestic containerization, and aggregate transloading.

Automobile Imports/Exports. During 1992, 30,000 automobiles were handled for Saab, Chrysler and Volkswagen by the automobile import/export industry at Quonset Point-Davisville. During 1993, however, the latter two companies have pulled out of Rhode Island in favor of sites served by tri-level rail, in Baltimore Maryland, and Wilmington, Delaware, respectively. Both companies indicated that the lack of tri-level access in Rhode Island was a major factor in their decisions. Sufficient space, competitive port costs, access to markets, and access by tri-level auto racks are all important factors in choosing a load center. On the East Coast, Quonset Point-Davisville is a leader in the first three factors, but constraints that physically limit accessibility by tri-levels and operational flexibility limit its attractiveness as a load center. While existing load centers offer sufficient space, competitive port costs, and access by tri-levels, Rhode Island would appear to offer better proximity to major markets, with nearly 80 million people located within 500 miles. If tri-level access to the Port of Davisville at Quonset Point were provided , it is estimated by Rhode Island officials that import/export activities alone would grow to roughly 100,000 vehicles annually, an increase of 300 percent annually from 1992 levels.

Container Traffic. Intermodal container traffic has grown dramatically in the past decade and is projected to continue through the year 2000 at a rate of 7.6 percent annually, although it may be limited by the lack of adequate terminal capacity. Rhode Island's report indicated that nearly all existing terminals in New England are approaching capacity due to the unavailability of suitable land. Davisville, however, not only has sufficient suitable land, but is also desirable because it provides vast quantities of existing rail served property as well as proximity to major highways and markets. A growing volume of containers would support an intermodal terminal of approximately 30 to 40 acres and four dedicated trains daily, servicing a growth to roughly 50,000 container units annually. The report concluded that without double stack access, there is little future for domestic containerization at Davisville.

Aggregate Transloading. Another likely opportunity for freight generated by the provision of intermodal rail-marine transportation at Davisville involves the transloading

of construction aggregates, including sand, gravel, and rock from rail cars to barges, and ultimate movement to other eastern seaboard locations. The Rhode Island study indicated that most general cargo ports in the region lack either rail access or suitable storage space for aggregate materials. Direct marine-rail access was seen as being critical to the development of the New England aggregate export market, as aggregate is a relatively low value-high volume cargo and many of the region's sources are located on existing railroad lines. Davisville, with its excellent rail connections was seen as being particularly suitable to capture a fair amount of the coastwise trade. The market for New England aggregate is seen as growing, as traditional sources of aggregate materials for the New York region have dwindled at the same time that the demand for aggregate in New England has dropped. Many New York area aggregate receivers are located on the water and are accustomed to receiving materials by barge. The study concluded that traffic would be sufficient to support at least one train daily consisting of 25 cars for moving aggregate from New England quarries to the Davisville piers.

Analysis. With intermodal improvements made to the port, most significantly dedicated access, vertical clearances to accommodate the double stack/tri-level cars, and direct rail-marine connections made for aggregate transloading, Davisville may in fact be able to establish itself as New England's newest general cargo port location.

It would appear unlikely, however, that a large-scale container shipping operation could be established at Davisville, given the existing fragmentation of this market between Boston and Portland, (for northern New England), and the relative proximity of Davisville to both Boston and its main competitor for land-bridge and southern New England traffic the Port of New York and New Jersey. Both Davisville and Boston seem to be coveting the same market, namely Midwestern shippers and cross-county traffic which would enter New England from the west via Conrail and Worcester. This market, and the market for goods to and from New England itself, is probably too small to efficiently split among more than one port, and the shipping companies themselves have shown increased reluctance to make multiple stops with their common carrier vessels, which adds time and cost to ocean journeys.

Davisville could become a major player in the container business if Boston finds it impossible, due to political, environmental, or other reasons to make the improvements necessary to become a modern container port (i.e., rail improvements, etc.) If Boston does succeed in making these improvements, however, a more likely scenario for Davisville may be to diversify and handle a variety of non-containerized cargo, including bulk, and neobulk commodities, autos, and aggregates, and establish itself as an important niche port for southern New England.

5.4.3 Overview of Recent Marketing Activities at Niche Ports

Several of the so-called "niche" ports, which specialize in a particular commodity or hinterland, have also prepared marketing studies in recent years.

Eastport, Maine

The Port of Eastport has experienced a dramatic increase in cargo tonnage since the construction of the existing breakwater pier which was completed in 1983. Continued expansion at this facility, however, is hampered by the severe lack of storage, staging and warehousing capacity due to its downtown location.

In order to evaluate future growth needs, the Eastport Port Authority commissioned a market analysis by Booz Allen and Hamilton in 1990, which identified physical improvements necessary to attract additional business to the port. The first phase of these improvements, a warehouse and debarker, have been constructed.

Cargo Traffic

At the present time the traffic at Eastport consists almost exclusively of two commodities – woodpulp and log exports. Because the port offers cost advantages to the small, but economically important timberland area of northern Maine, the 1990 study concluded that the primary additional market opportunities will also be in the forest products trade. A survey of regional shippers was used to identify the potential specific target market that could be considered "near certain" for Eastport, given some port improvements, and found that this category mainly consisted of increased volumes of existing Eastport commodities, such as logs, lumber, woodpulp, and oriented strand board (chiefly breakbulk cargoes.)

The survey also identified new "possible" commodities for Eastport, which would require more intensive investment in physical plant and service improvements. The items in this category included other types of forest products and granite which currently do not move via Eastport, and also included a domestic barge service between Eastport and the southern U.S. lumber producing areas. This barge service would transport paper-making materials which presently reach Maine by rail.

Under the "most likely" market scenario identified in the study, Eastport's total tonnage would increase from the 1990 level of approximately 250,000 tons to almost 400,000 tons in the year 2000. The marketing projections are based largely on the continued pace of overseas construction requiring wood products, (especially in the primary markets of Japan, Western Europe and Latin America) and the pre-eminent position of the U.S. forest products industry.

The study concluded that Maine will likely remain an active participant in U.S. forest product export trade. It is the sixth largest timberland state in the U.S., and the second highest ranking state in terms of private ownership of timberlands. The restriction of the export of logs from federally owned timberland in the Pacific Northwest is seen as diminishing that area's role in international trade, leading to a positive outlook for continued growth of Maine's exports.

Searsport, Maine

As a result of market demand, Searsport became the proposed site for construction of a major international cargo port, which would be located on Sears Island, across the harbor from the existing facilities at Mack Point. The Sears Island Cargo Port has been actively

promoted by the Maine Department of Transportation for a number of years, and is projected to diversify the area's marine commerce by handling containers and wood products such as wood chips. The $21 million facility was begun in 1984 but was halted in 1985 when it was determined that an Environmental Impact Statement (EIS) would be necessary. The EIS was completed and work resumed in 1988. Lawsuits against the project were brought by the Sierra Club and other groups and work was again suspended in 1988. Preparation of a supplemental EIS is presently underway, and the document is scheduled to be released for public agency review in mid-1994.

Cargo Traffic

According to a report on market demand compiled by Booz Allen and Hamilton in 1992, the most likely demand for a new port facility at Searsport in a 1992 baseline year, is 58,600 tons of container, 57,900 tons of breakbulk cargo, and a potential 600,000 tons of woodchips to be exported. A number of new conditions have occurred in the last five years to help determine market potential.

A plan to expand the facilities of the Port of Portsmouth, New Hampshire is currently under construction. While the port is expanding, it will still have limited capacity and has an inland cost disadvantage in serving Maine cargos. In addition to the scrap metal that the Port of Portsmouth presently serves, the port has targeted logs, woodchips and scrap paper sources which are primarily from Vermont and New Hampshire. More compelling however, is the limited size of the facility, both before and after expansion, and the inland transportation cost disadvantage. This leads to the conclusion that the expansion of Portsmouth will not result in a diminution of cargo volumes for a new facility at Searsport.

The container feeder service at Portland will diminish the projected container traffic for Searsport by an estimated 20 percent. The select shipper interviews conducted for this study indicate that Maine customers who use the feeder are very pleased with the service. The estimated 20 percent reduction of demand for a container service at Searsport results in a projected container tonnage of 58,600 tons.

The outlook is for continued and strong growth in U.S. forest products export. Of that forest products demand, virtually all was in export trade. Restrictions have prompted the major buyers of American forest products to seek permanent replacement for continued West Coast shortfalls. Woodchips are used for making paper, and the U.S. paper industry remains one of the strongest and best positioned industries in the U.S. economy. Of the sectors of most relevance to the port, wood pulp and wood chip exports increased by an average seven percent per annum and paper and newsprint exports increased by an average 10 percent per annum. Starting in 1988, there has been a doubling of export volumes in U.S. exports of woodchips and is widely believed to be the start of a continuing strong growth curve. Bowater, Inc. has acquired selected Georgia Pacific properties in Maine and is constructing a recycling plant at the Millinocket site which is within Searsport's hinterland.

The 1992 study for Searsport concluded that low port and transportation costs are critical to capturing and serving European customers. A new port facility at Searsport is seen as serving a critical role in this trade, and will help ensure that Maine firms can compete in a

unified European Community. Even though it is believed that the container feeder service at Portland will diminish the amount of container cargo which could move over to a new terminal at Searsport, it is believed that the remaining cargo is sufficient to induce a feeder service. Dry cargo handled at the ports in Maine has increased more than four-fold since 1981. A survey of 29 firms found that a number of firms are interested in exporting and believe that a new facility at Searsport would help them to do so. Three of the firms are still involved in exporting and are still very supportive of new port development at Searsport, all of them forest products firms.

New Bedford and Fall River, Massachusetts

The Massachusetts Department of Environmental Management, which owns the main cargo facilities at New Bedford and Fall River has not done any recent studies regarding the potential for growth of traffic at these ports, although a study of potential growth markets for New Bedford is reportedly underway as of late 1993.

New Bedford seems to be a likely candidate to benefit from the increased traffic into New England of agricultural and food products. This sector is the only one of the commodities studied that experienced steady growth in the 1989-1991 time period, with New Bedford maintaining its share of the market. This is partially due to New Bedford's unique service in offering importation of palletized fresh fruits from northern Africa and South America, and its regularly scheduled trade between southeastern Massachusetts and Portugal, the Azores, and the Cape Verde Islands. New Bedford should also remain strong in both the landing of fish and the import/export of processed fish products.

Fall River almost exclusively traffics in petroleum products, and the port's individual share of the overall New England market should remain at its present level.

New London, New Haven and Bridgeport, Connecticut

The Connecticut ports are currently under study for analysis of future growth needs.

New London's facility suffered a physical collapse during 1993 and is currently inactive. Prior to that event, New London had experience marked declines in its primary non-fuel commodities of lumber, agricultural products, and chemicals and fertilizers. New London's fate would appear to be intimately tied to that of the Central Vermont Railroad, which has its southernmost terminus at the port and serves the upper Connecticut River Valley areas of New Hampshire and Vermont. The railroad is reportedly to be sold by its owner, the Canadian National Railway system in the near future. New London's traffic volumes will also be affected by the continuing decline of the agricultural industry of northern Vermont, which provided much of the port's hinterland market.

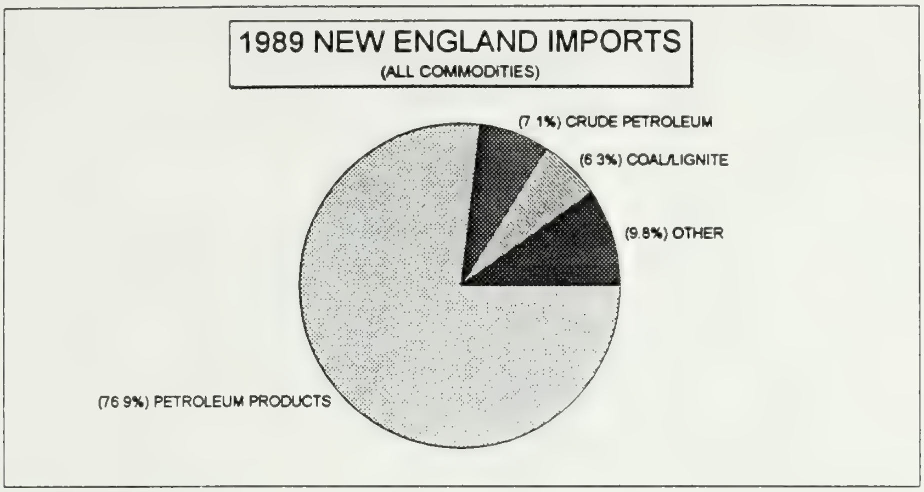
New Haven continues to maintain its import share of bulk materials such as cement and chemicals, which primarily serve the local area. Its main export of scrap iron and steel, however, experienced a decline in the 1989-1991 time period. Due to the port's heavy reliance on this traffic, this may turn out to be an area of some concern.

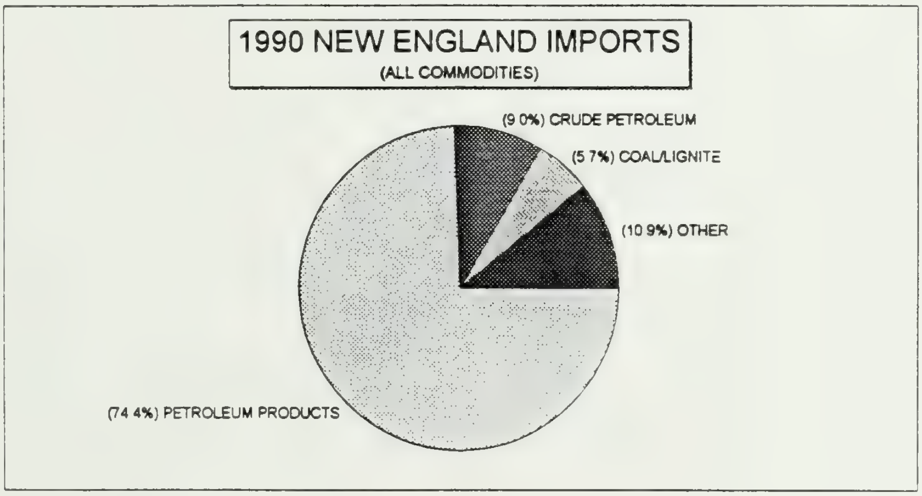
Bridgeport, like New Bedford, appears to be benefiting from an increased importation of agricultural and food products, particularly tropical citrus fruits and bananas. As long as

there is a demand for non-containerized imports of these products, Bridgeport, which is currently allied with a Toronto-based fruit importer, will have a steady niche to fill in this area. In exports, Bridgeport has also shown a steady growth between 1989 to 1991 in the shipment of pulp and paper products. This may turn out to be another unique market in which this southern New England port can establish itself.

Figures

Figure 5.1 New England Imports, 1989-1991 – All Commodities





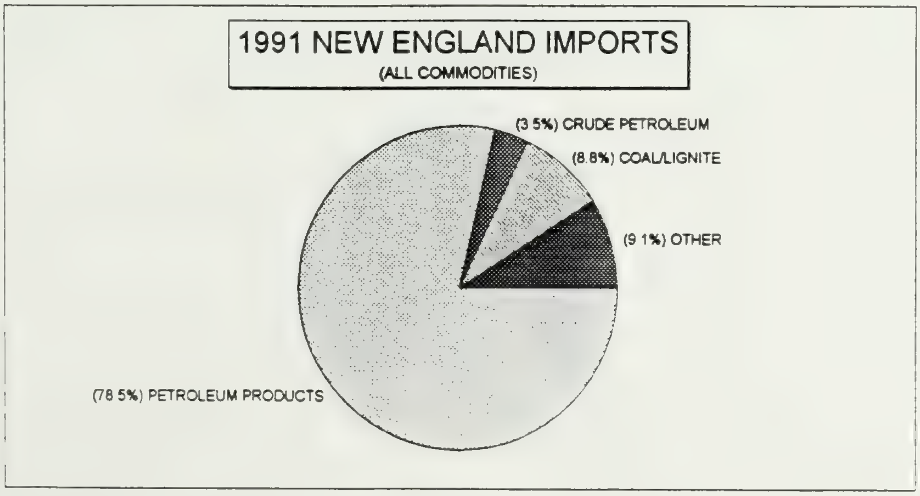


Figure 5.2 New England Imports, 1989-1991 – Non-Petroleum/Coal

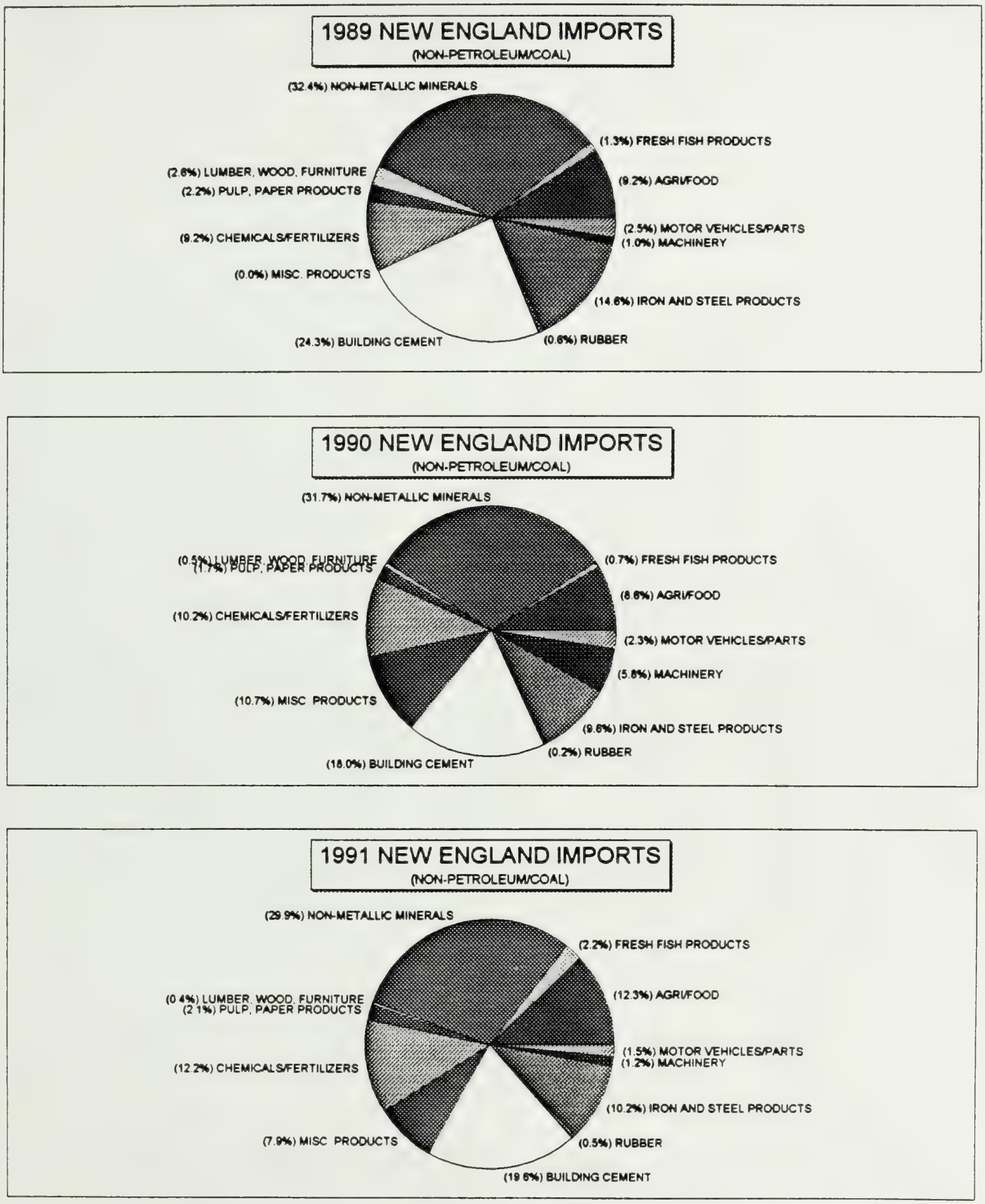


Figure 5.3 All New England Ports Studied, Fuel Import Trends

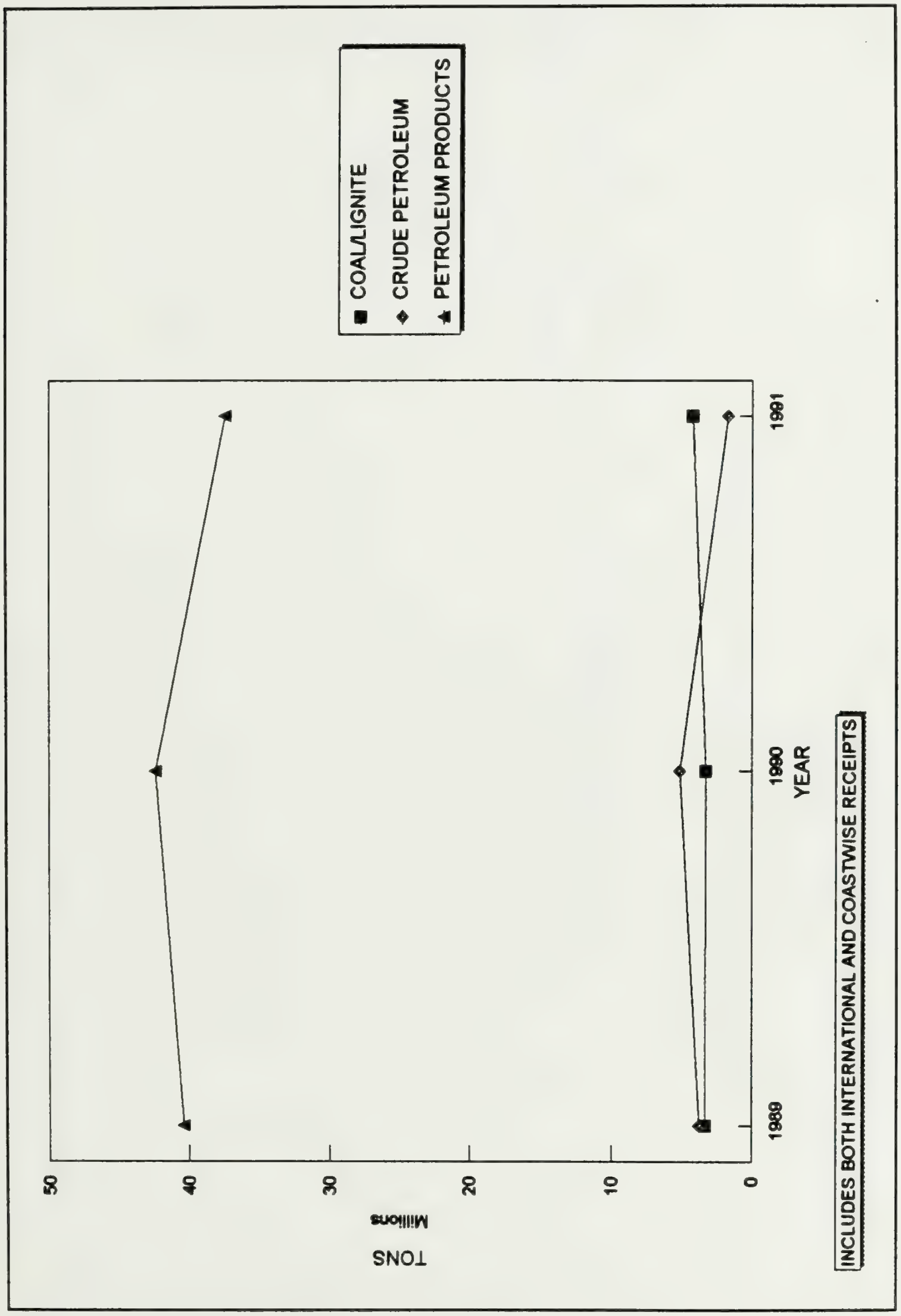


Figure 5.4 All New England Ports Studied, Non-Fuel Import Trends

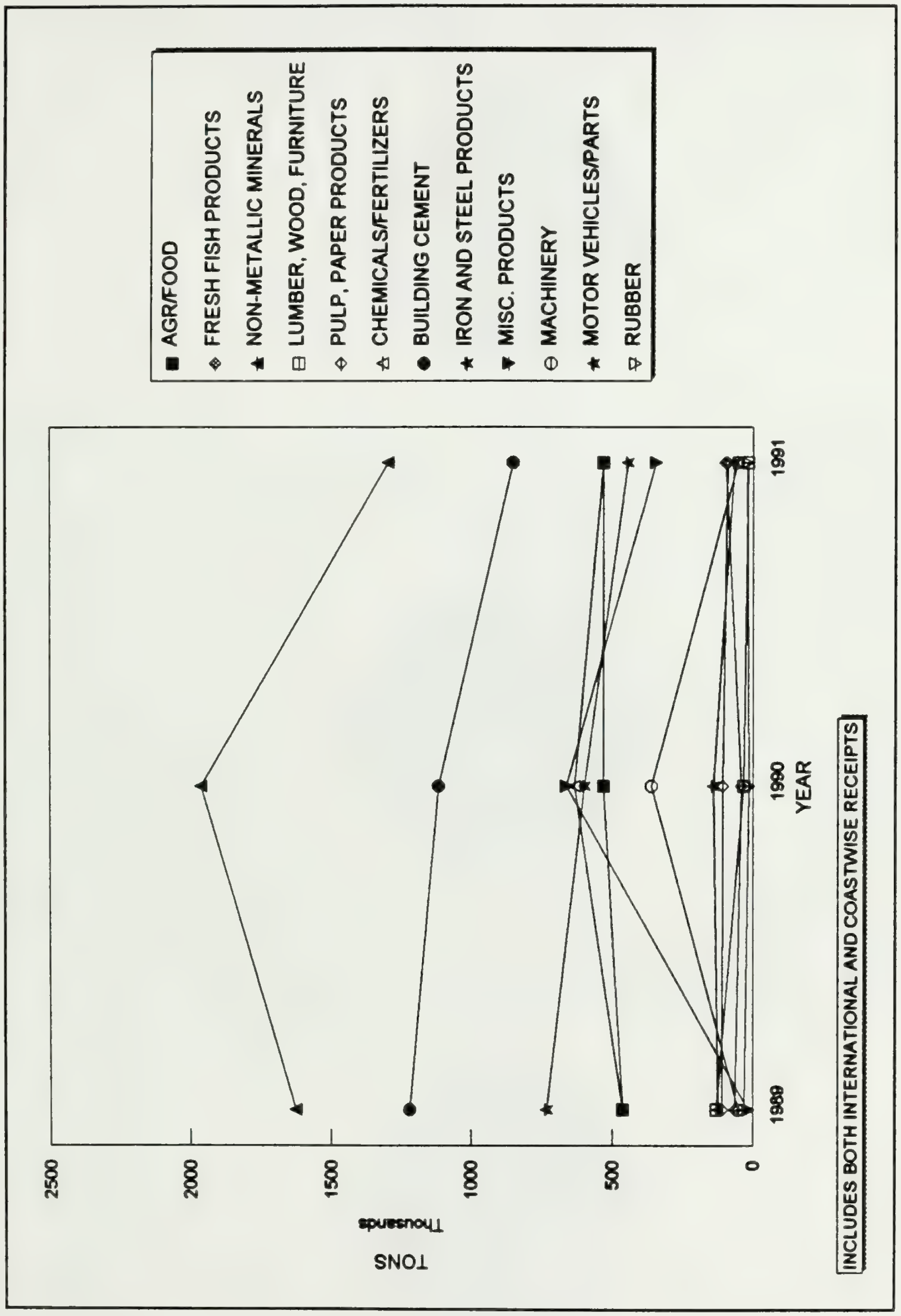
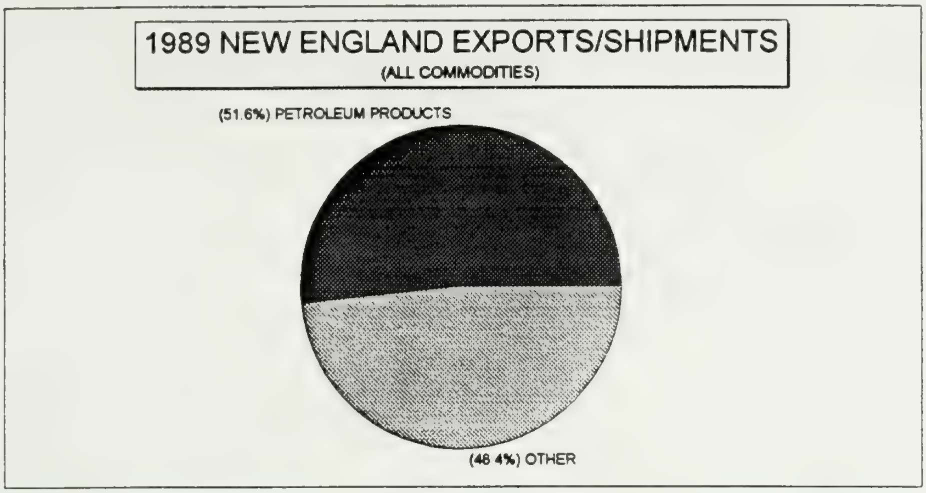
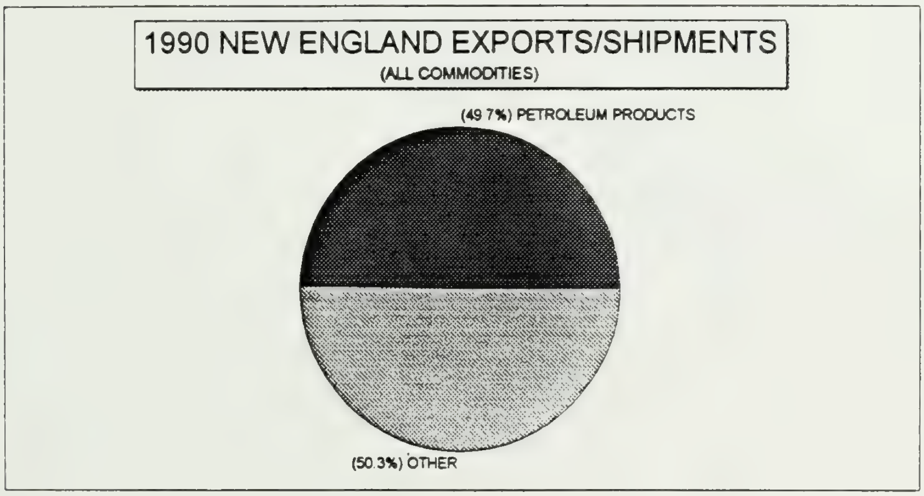


Figure 5.5 New England Exports/Shipments, 1989-1991 – All Commodities





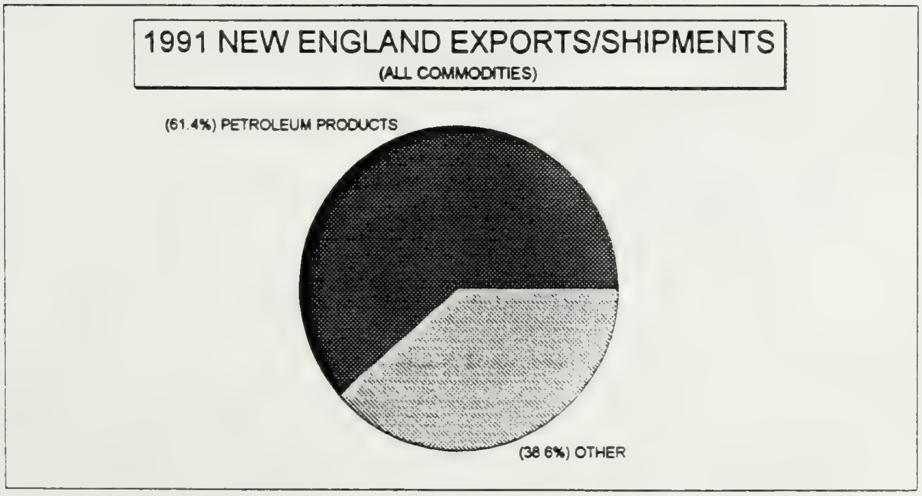
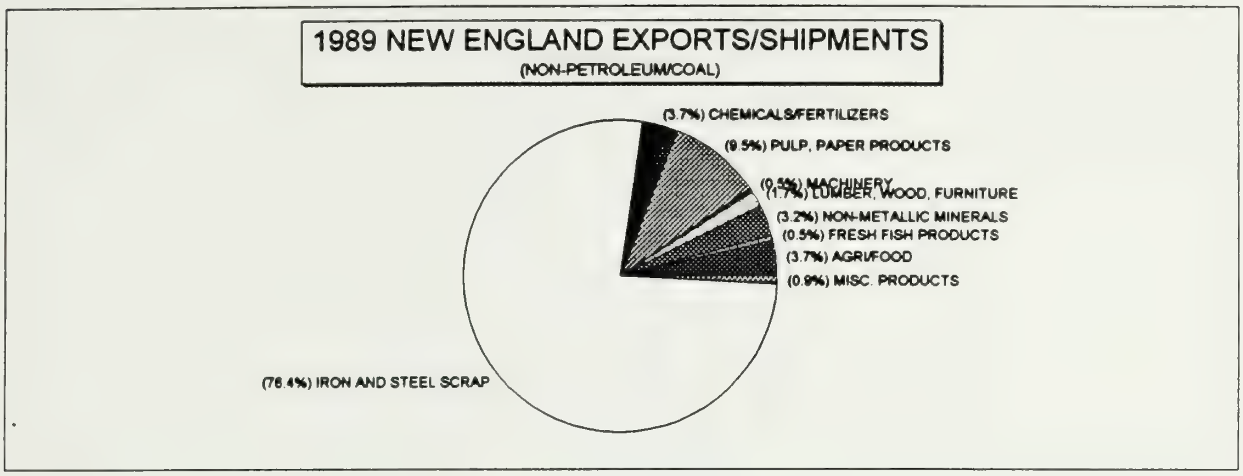
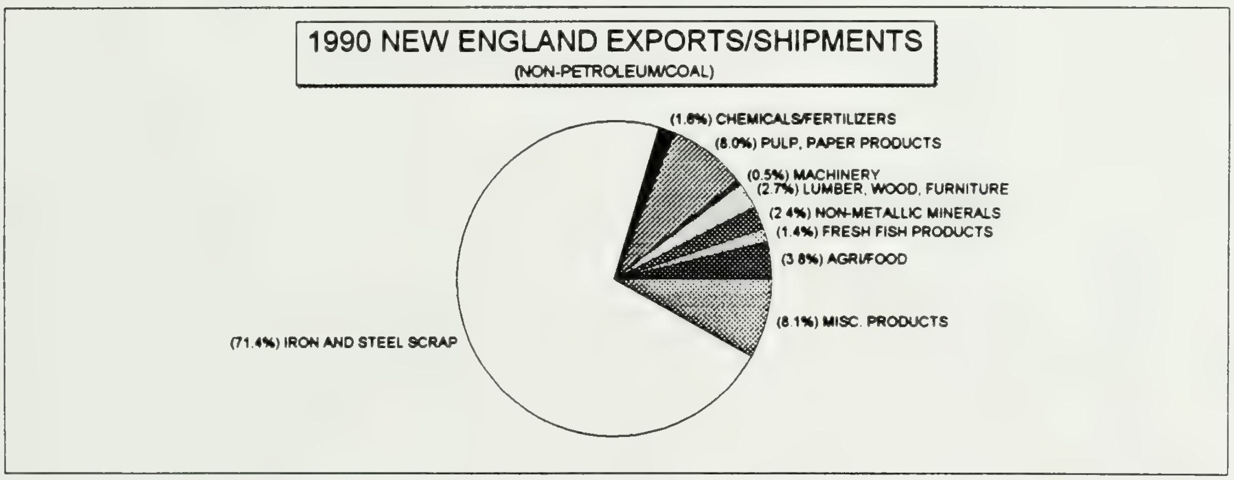


Figure 5.6 New England Exports/Shipments, 1989-1991 – Non-Petroleum/Coal





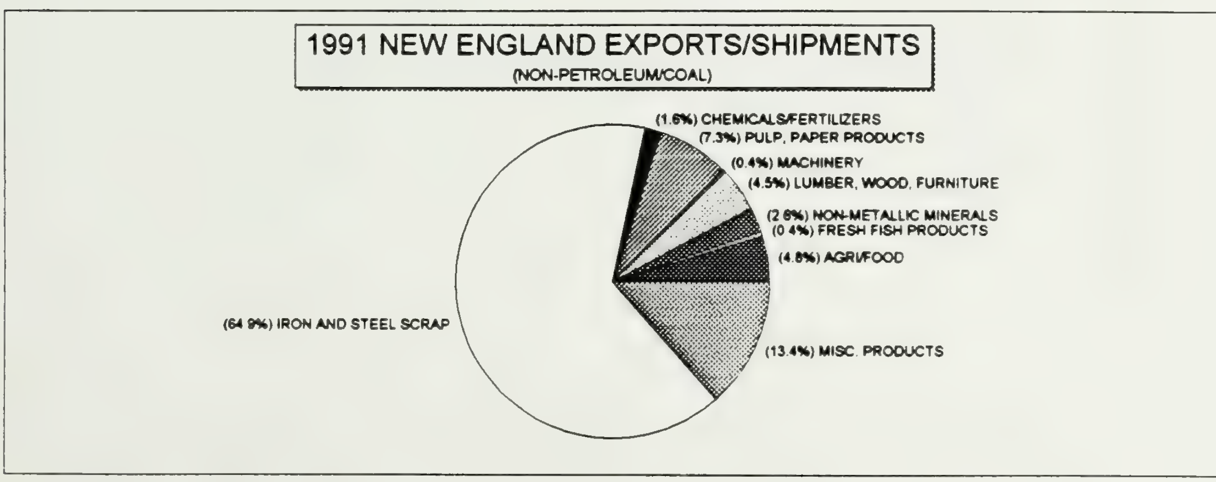


Figure 5.7 All New England Ports Studied, Non-Fuel Export Trends

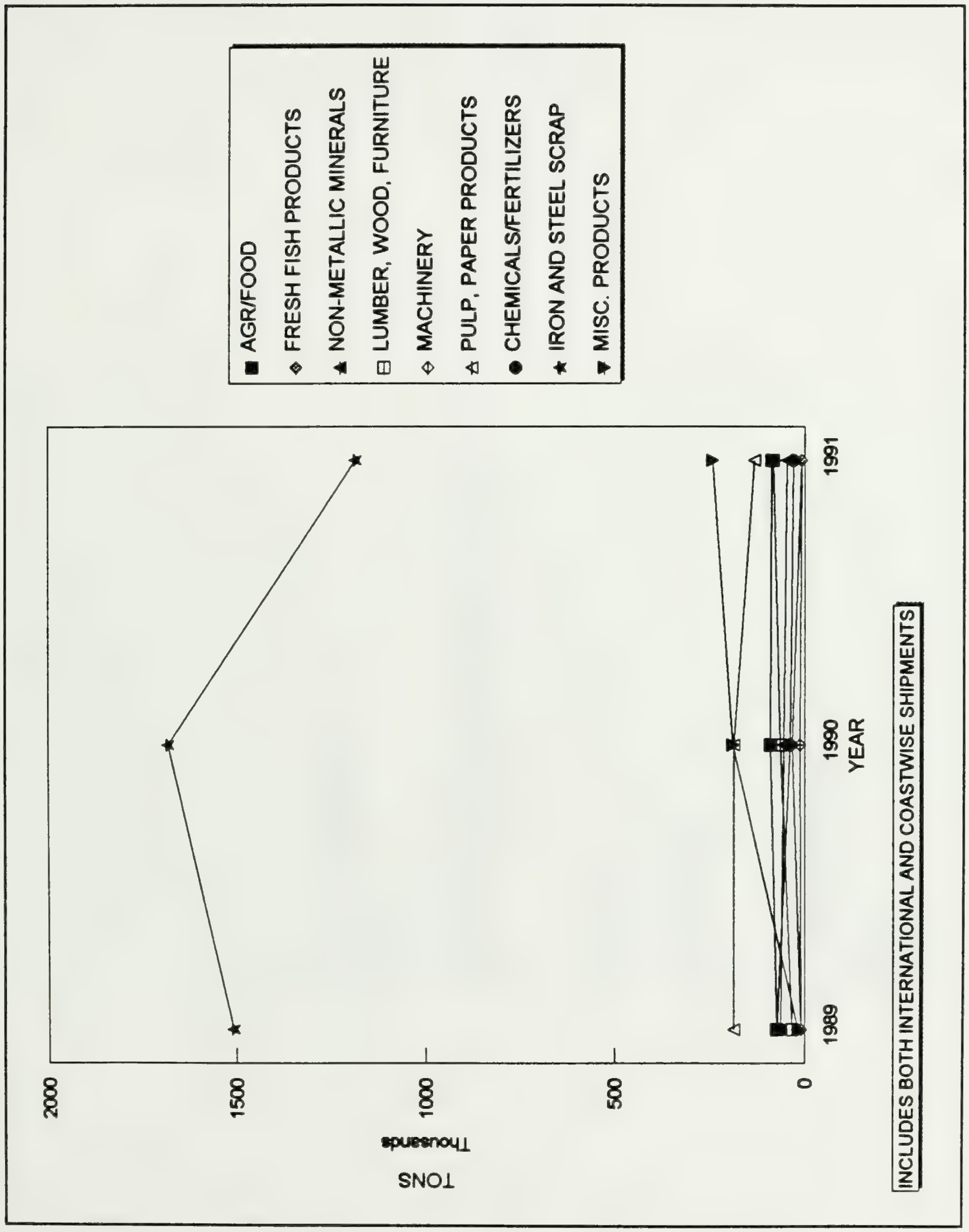


Figure 5.8 1991 New England Port Volumes, All Commodities

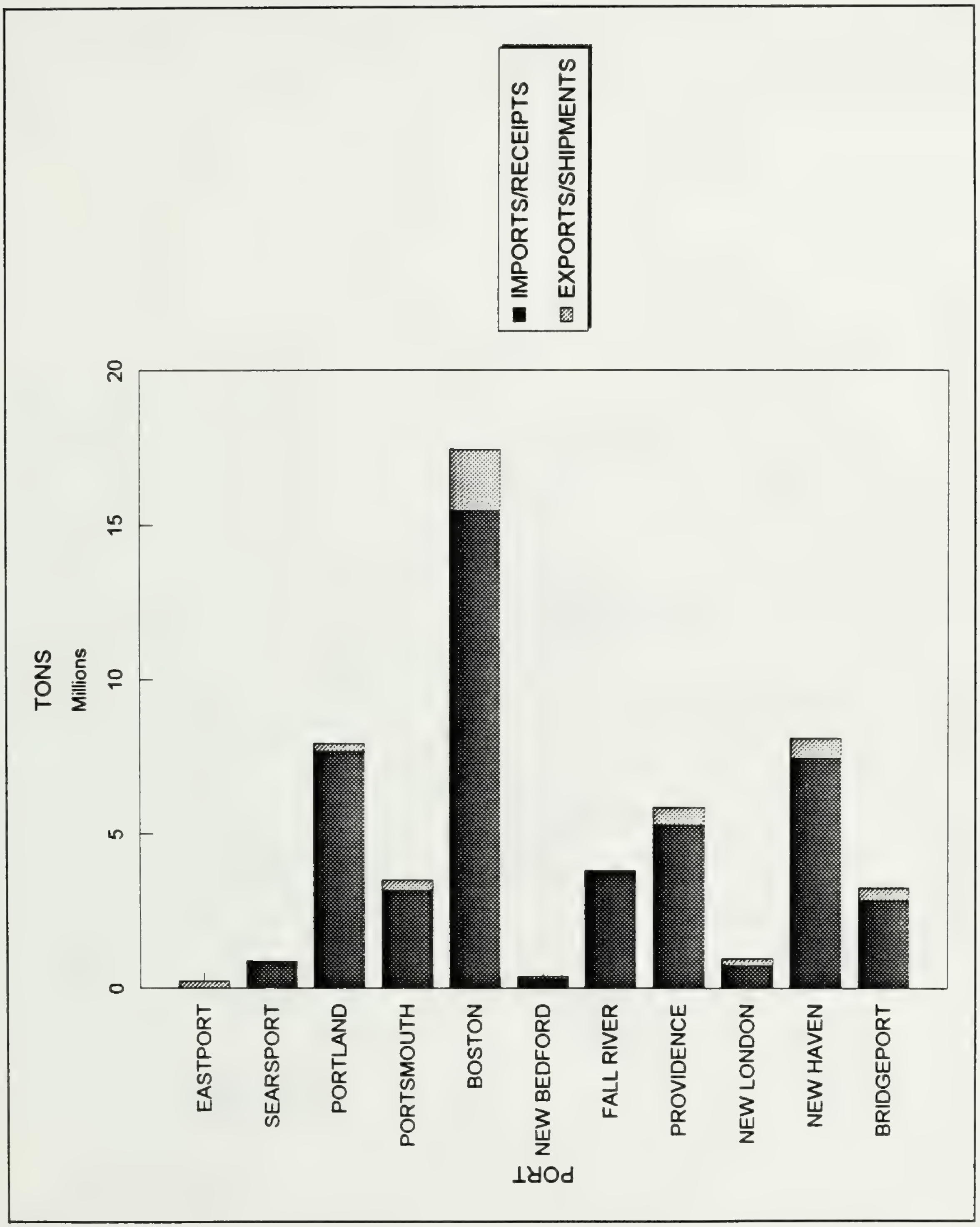


Figure 5.9 1991 Non-Fossil Fuel Cargo Imported by Port

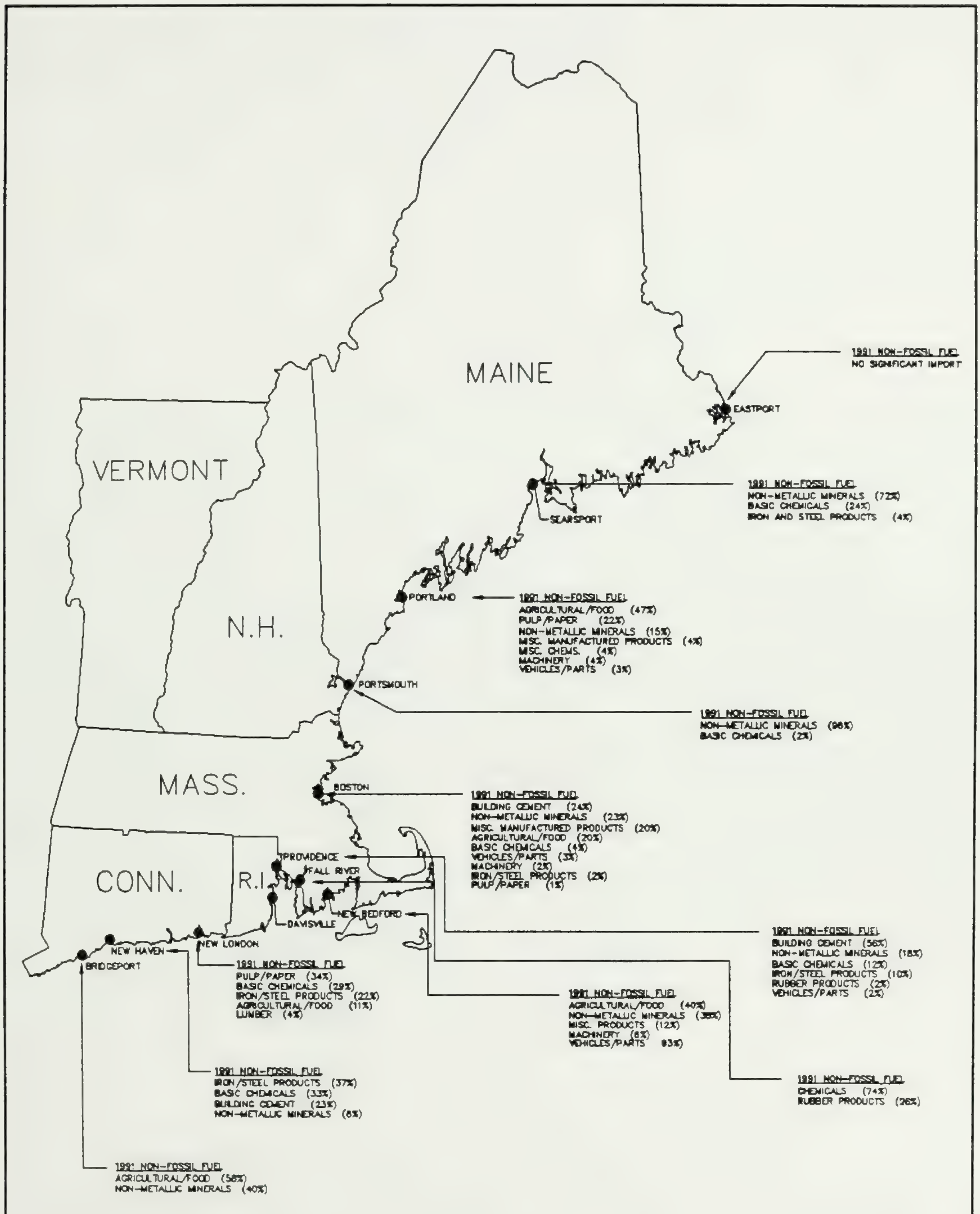
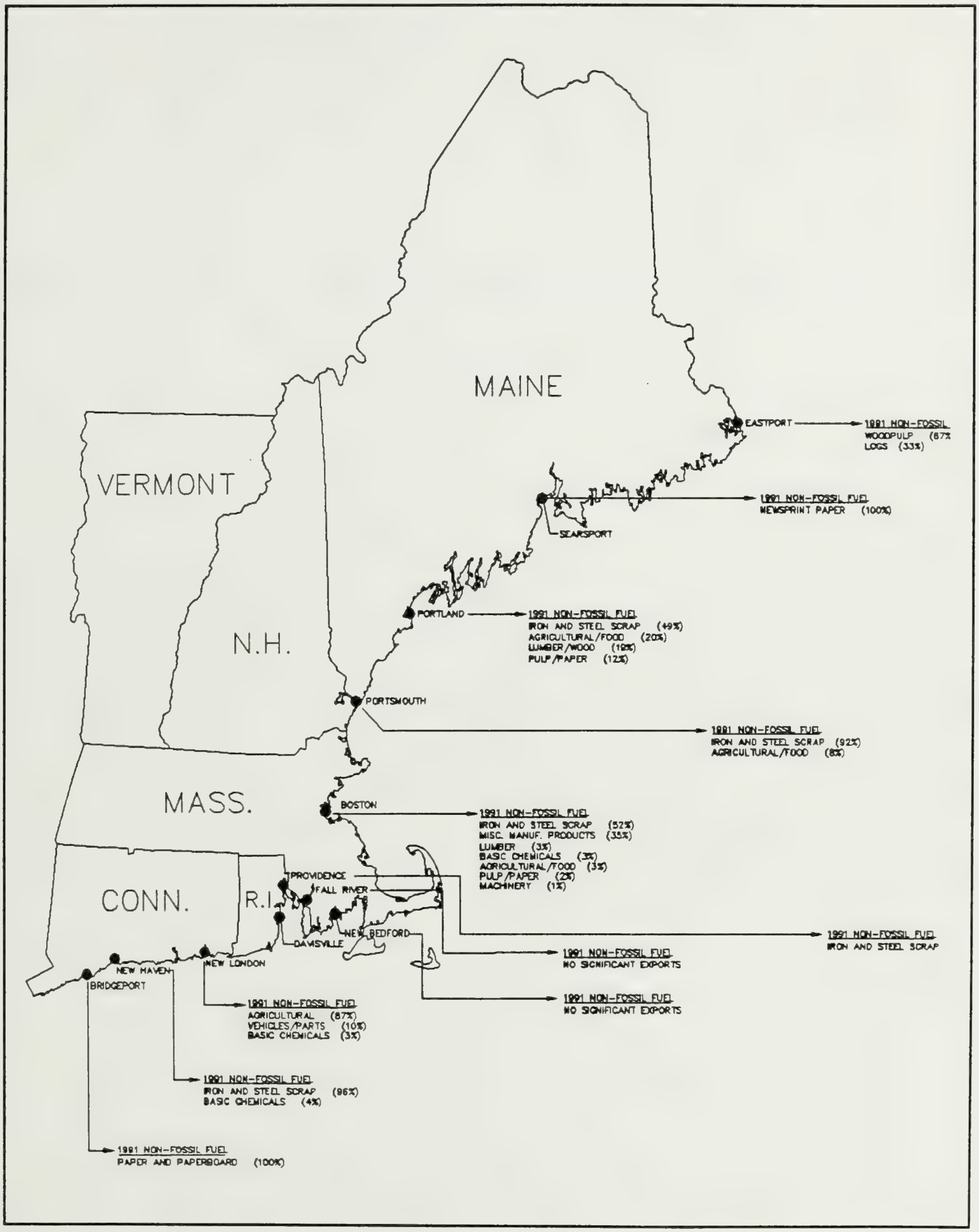


Figure 5.10 1991 Non-Fossil Fuel Cargo Exported by Port



6.0 Trends in Commuter Behavior

6.0 Trends in Commuter Behavior

6.1 Introduction

In the NETI Draft Inventory Report (February 1994), Chapter 6.0 was entitled Telecommuting and summarized some of the telecommuting activity occurring in the United States. In continuing telecommuting research for this forecasting task of the NETI study, the topic was broadened to include several aspects of commuter behavior beyond the strict definition of telecommuting.

As defined by the Federal Transit Administration, telecommuting is:

> an approach for reducing home-to-work trips by allowing employees to work at home. Employees may be linked to the work place by computer and modem, or simply may take work home requiring no computer. Telecommuting employees usually work at home one or more days per week. Related options include employees working at satellite work centers (run by single employers) or neighborhood work centers (run by multiple employers). The centers usually are equipped with computer and modems and connected to a main office.

Telecommuting has received much attention from transportation officials who see relevance to trip reduction/congestion management, environmentalists who see potential air quality benefits, and the telecommunications industry which provides the means for workers to successfully telecommunicate. In fact, many pilot telecommuting programs have been tested throughout the country, including Washington, Hawaii, Washington D.C, and particularly California, where trip reduction strategies and implementation are required under the 1990 Clean Air Act Amendments. The Clean Air Act requires a trip reduction for companies of 100 or more employees at a work site in regions of the country which do not meet defined criteria for attainment of air quality standards (see Chapter 8.0 of the Inventory Report). The goal is to reduce single occupancy vehicle trips and improve average vehicle occupancy by 25 percent. To this end, the Federal and California governments have sponsored the creation of a telecommuting handbook. The 1991 handbook, entitled "Telecommuting – Moving the Work to the Workers," was written by Commuter Transportation Services, Inc., and outlines how to initiate, manage and adapt a telecommuting program.

Related to telecommuting are "second tier" commuter actions which also reduce the number of home-to-work trips, or at least shift the trips from the peak hour, but do not require the employee to work at home. Daily commute patterns are altered through use of flextime and staggered hours. These "second tier" actions do not require any investment in at-home equipment but are dependent upon businesses structuring commuter options which benefit both management and workers. Examples include the flextime programs

offered by many employers, federal government offices, Seattle's downtown businesses and the Tennessee Valley Authority.

The telecommuter requires some method of communicating directly and easily with associates in the office and clients in various locations. Beyond specific work policy changes which allow workers flexibility in their commute, the influence of telecommunications capabilities on business is advancing the basic way we will communicate, and telecommute, in the future. As stated by the U.S. Department of Commerce, "Telecommunications are the tools through which telecommuting activity can grow and allow intermittent or continual work-at-home days to become a conventional way of making a living." The impact of improved telecommunications cannot be underestimated as a factor in how future business will be transacted, how customer service will be rendered and how services such as education and health care are administered. In short, improved telecommunications will be an increasingly influential factor in our future trip-making decisions.

The advantages of telecommuting may include reduced travel time and cost, reduced meal costs, and increased schedule flexibility and availability to family. The worker, however, may feel isolated, be concerned with career advancement, and have a tendency to overwork. The employer may benefit from telecommuting through increased productivity, reduced overhead costs, increased employee satisfaction and reduced sick days. The disadvantages to employers may include the additional cost of telecommunicating equipment, change in management techniques and concerns over worker productivity, supervision and safety.

■ 6.2 Historic Perspective on Commuting

Prior to WWII, the economic and job centers of this country were located in cities, with workers tending to live close by and commuting to work via rail. After WWII, the economic prosperity increased desire for single family housing increased private automobile ownership, and various public policies induced workers to purchase a suburban house and automobile and drive to their job in the city. The continued suburbanization of America occurred as both retailers and companies followed residents out of the city. The "malling of America" satiated the retail demands of consumers concentrated in the suburbs. Companies realized that the suburbs offered a cost effective alternative to the urban office location through reduced land costs, the availability of expansion land, and proximity to worker residences. A prime example is the Route 128 belt located 15 miles from downtown Boston. Furthermore, continued development of the suburbs have created "edge cities," concentrations of suburban development which satisfy "urban" lifestyles by providing jobs, entertainment, and recreation previously satisfied by traditional city centers.

The travel demands caused by the evolution of the suburb are often greater than the capacity of the existing roadway system, creating increased congestion and travel times, not only during peak hours but off-peak hours when non-work trips occur.

Simultaneously, improved communication technologies have allowed some businesses to splinter their offices and move part of their operation to non-urban "back office" locations. Many companies are two fold operations – the managerial face-to-face client contact component, and the administrative function component, such as the claims and financial departments. These administrative departments, often self-sufficient and requiring little contact with clients or other departments, are increasingly being relocated to an area outside the urban "corporate headquarters." Remote locations offer benefits by providing lower land costs, lower labor costs, and, some claim, a better educated work force than that available from urban schools. Insurance and credit card companies are among those who deal predominantly with these types of data and have created back office locations. Aetna Insurance of Hartford, CT has back office operation in both Fall River, MA and Elmira, NY. Travelers Insurance and Hartford Insurance, both of Hartford, have operations in Glenn's Falls and Utica, NY, respectively.

While remote location represents a slower long-term trend in how business actions will affect transportation patterns, the activity highlights how telecommunications to date have changed the fundamental way companies decide where to locate and consequently, how and where workers will commute.

6.3 Current National and New England Commuting Trends

Combined with the commuter trends occurring as a result of business location, a multitude of demographic and societal changes are also shaping general travel and commuting characteristics. National and regional data are discussed in this section.

Table 6.1 highlights results from the 1990 National Personal Transportation Survey (NTPS). The marked trends are decreasing household size and the simultaneous per household increase in workers, drivers and vehicles. The total increase between 1969 and 1990 in workers/household is entirely the result of more women on the workforce. In 1969, women comprised 36 percent of the workforce, and by 1990 this rate had reached 46 percent.

In 1969, 68 percent of eligible persons had driver's licenses, while by 1990 this rate increased to 88 percent, reflecting a 2.2 percent annual growth. The number of vehicles/household has been increasing steadily during the past 20 years to a current rate of 1.77 vehicles/household, reflecting the country's continued, and increasing, dependence on the private automobile.

The total annual household vehicle trips have been increasing at over three percent per year. Overall, about 22 percent of all person trips in the country are work-related. It is this

22 percent which can be significantly affected by telecommuting. Workers are traveling further to get to work with an average trip of 6.1 miles in 1983 increasing to an average of 7.7 miles by 1990.

Additionally, census data provide an overview of changes which are happening throughout the country and regionally. Table 6.2 summarizes 1980 and 1990 demographic and travel to work data for each New England state. Perhaps, the most remarkable trend is the overall increase in the private automobile as a means to travel to work. Nationally, in 1980, 86 percent of workers used private vehicles (including carpool) for commuting. By 1990, this rate increased to 88 percent. Simultaneously, carpool use decreased by eight percent. In New England, this trend was more pronounced with an eight percent to 20 percent decrease in carpooling. It is also interesting to note that transit usage has remained stable or declined, and is similar to the number of people who walk to work.

Table 6.3 presents commuter data for a sample of New England Metropolitan Statistical Areas. The local level results echo the national trend. In Boston, for example, the number of carpooling workers dropped from 18 percent in 1980 to nine percent in 1990. Stamford, CT, Bangor, ME , Providence, RI, Burlington, VT and Portsmouth, NH all experienced similar declines with 1990 carpooling averaging 12 percent. This trend away from carpooling is also shown in the decrease of average vehicle occupancy (AVO). As shown in Table 6.3, AVO dropped from a 1980 average of 1.14 to 1.23 to a 1990 range of 1.06 to 1.09 workers/vehicle.

Regionally, Table 6.3 also shows women comprising 45 percent to 48 percent of the workforce in 1990 up from 42 percent to 44 percent in 1980. Of these working women, between 60 percent to 70 percent have children under six years of age, underscoring the non-traditional flexible work arrangements which will be necessary for all workers to balance work and family responsibilities.

These statistics convey the continued, and increasing, dependence on the automobile. The growth in single occupant autos as a means to commute to work is a serious hurdle in common policy goals of reducing traffic congestion and improving air quality. Many factors affect the commuter decision to convert from driving alone to start carpooling or switch modes, but until higher costs are incurred, through higher gas and parking prices, and to a lesser degree, time spent in traffic congestion, this trend will likely continue. While local commuter matching and carpooling programs should not be undervalued, their efforts alone will continue to have difficulty persuading drivers to leave their single occupant vehicle. Trip reduction regulations, as those required in California under the Clean Air Act, will result in commuter behavioral changes, but New England (with the exception of southwestern Connecticut) will not be subject to such stipulations and must develop other strategies if it aspires to reduce the number of automobile commuter trips.

In an attempt to develop those strategies, Massachusetts unveiled a Telecommuting Initiative in early February 1994. The one-year study, being managed by the Massachusetts Division of Energy Resources, will evaluate the environmental, economic and energy-savings benefits of telecommuting. The results of this study will document how not only Massachusetts, but also New England, can benefit from telecommuting strategies. The study will track 350 employees in the state, including employees for AT&T, Honeywell,

Massachusetts General Hospital, GTE, MIT, MCI, DEC, Nynex, and the State of Massachusetts.

6.4 Telecommuting Trends

Several factors including business location, increased auto ownership and the increasing number of household workers are contributing to congestion on existing roadways. One method to reduce these trips is to eliminate the demand for the trip by creating an alternate means to accomplish the purpose of the trip. For work-related trips, this reduction can occur through telecommuting, an activity currently being practiced throughout the country through formal and informal telecommuting programs.

A national survey by LINK Resources indicates that telecommuting grew 15 percent between 1992 and 1993 to about 7.1 million workers. Telecommuting occurs most often in companies with fewer than 100 employees due to the more flexible atmosphere. Telecommuting, both formal and informal, is supported by 35 percent of businesses. Telecommuters are 53 percent male and 47 percent female, reflecting the same distribution of the sexes in the workforce and indicating that the activity is "gender neutral." Nearly two-thirds of telecommuting households consist of dual earners and about 50 percent have children under 18, and 25 percent have children under six. Of those telecommuting, 36 percent own a personal computer, (twice the national average), 70 percent rely on telephone answering machine, 16 percent use modems and seven percent use a fax machine.

In 1993, major increases in telecommuting were noted among engineers, scientists, computer programmers and teachers. The largest increases by occupational sector were in business and educational services. While approximately one third of all telecommuters are contract workers rather than regular employees, the number of regular telecommuting has grown faster during the past three years.

The U.S. DOT predicts that by the year 2000, almost one third of paid work will be done at home. Also, five percent to 10 percent of the labor force will be involved in telecommuting three to four days a week, half working at home and half at a telework center.

While the U.S. population is projected to grow at 0.7 percent per year between now and 2002, the labor force is anticipated to grow at 1.2 percent per year. Information workers are currently about 56 percent of the labor force and are those most likely and able to take advantage of telecommuting since their work focuses on generating and communicating data and information, and is facilitated by the use of computers, modems, faxes and telephones. Jack Nilles of the Telecommuting Research Institute, projects that 10 to 20 percent of these information sector employees will become telecommuters within the next decade. Between 2000 and 2030 a steady growth in telecommuting participation is forecast to occur.

This forecast escalation in telecommuting will, of course, depend upon a variety of factors, including the willingness of employers to promote such activity, but the most important factor will be the continued and improved access to developing communications technologies.

6.5 Telecommunications Role in Commuter Behavior

Telecommunications are the tools which will allow workers to be remotely located and still be able to directly communicate with co-workers and clients in a variety of places.

One facet of the telecommunications market is the "teleconferencing center." These centers are located in most major cities and through the use of large video screens and audio equipment, allow participants to conduct a meeting between persons in numerous locations. While video meetings may be impersonal, the simple cost calculation of videoconferencing versus multiple business trips compels companies to seriously consider this option.

The July 1993 Strategic Assessment Report prepared by the Massachusetts Aeronautics Commission addressed the future impact of telecommunications on the airline industry. The study portrays a future where telecommunications will reduce the demand for some types of airline trips as videoconferencing and desktop videophones become commonplace. By 2030, the current trends indicate that each workplace desk will have both videoconference and data transfer capabilities. As the accessibility to these services increase, the demand for business travel will consequently decrease. By 2010, the study forecasts that telecommunications may replace up to seven percent of the projected enplanements at Logan International Airport. Branch office trips, inter-company trips, training and conference trips may each be reduced through videoconferencing technology.

In Arthur D. Little's 1991 study entitled "Can Telecommunication Help Solve America's Transportation Problems?," the benefits of telecommunications as a trip substitution measure are quantified. The study highlighted a variety of trip types which may be substituted by telecommunications, including commuter work trips, shopping trips, business trips, and truck and airplane trips which may be replaced with electronic transfer of data. Benefit comparison of this telecommunication trip substitution to intelligent highway vehicle systems (IVHS), which would make better use of existing roadway systems, alternative fuels conversion which would reduce pollutants, and high speed transit which would provide a time-effective alternative while reducing pollutants and congestion, led to the conclusion that telecommunications improvements can offer significantly more benefit for less cost. The study estimates that a 10 percent to 20 percent trip substitution by telecommunication would nationally provide $23 billion in benefit of reduced emissions, fuel savings, travel time and roadway maintenance. By contrast, savings associated with the three alternative travel improvements are forecast at $10-$13 billion.

Telecommunications continuing effect on how the world will communicate is immeasurable. Advances are occurring daily, but the results are not always positive. AT&T recently (February 1994) announced that due to telecommunication improvements displacing the human worker, a total of 15,000 layoffs nation-wide were anticipated over the next five years. The importance of telecommunication to this region, however, is positively emphasized by the formation of the Massachusetts Telecommunications Council. Formed in June 1993, its purpose is to "promote Massachusetts as a world center for telecommunications and to take advantage of the extraordinary high concentration of telecommunications organizations already located (within the state)." The mission of the Massachusetts Telecommunication Council is to promote the state of Massachusetts as a world center for telecommunications and to help Massachusetts-based telecommunication businesses to succeed.

6.6 New England Potential

A continuation of national background trends will slowly change our society and affect commuter behavior. As the number of workers per household increases, families encounter complex child and relative care arrangements. Vehicle per household ratios have been increasing, accenting our dependence on the automobile. Average commutes have been increasing, both in terms of miles and time. Unrestrained, these trends will expedite traffic congestion and air pollution, and affect general quality of life. The increased use of telecommuting as a way to allow workers to remain at home for some portion of the week may serve to slow these negative consequences and offer residual worker satisfaction. Simultaneously, telecommunications advances will allow instantaneous transfer of images and data, reducing the fundamental need for many types of trips.

Economic trends indicate that New England will follow the national trend of an increase in financial, insurance, and real estate jobs, while encountering a decrease in manufacturing jobs. Of the ten employment sectors defined by the Bureau of Economic Analysis (BEA), jobs within seven sectors are not likely to be affected by commuter behavior changes. These sectors include Farm, Agriculture, Mining, Construction, Manufacturing, Transportation and Public Utilities, and Trade where workers, in general, are required on site and often in shifts to perform their job. Currently in New England, jobs in these sectors comprise 50 percent of the workforce. Commuters within the remaining sectors are more likely able to participate in telecommuting activity. Jobs in Finance, Insurance and Real Estate, Services and Government comprise the other 50 percent of the New England workforce and forecasts indicate that this rate will increase to 53 percent by the year 2040.

By the year 2000, 4.67 million workers are forecast to be employed within the New England Finance, Insurance and Real Estate, Services and Government sectors. With a 10 percent telecommuting participation rate on two days a week, a total of 467,000 telecommuting workers would effect a two percent reduction in the number of single occupant vehicle commute trips made in the region (assuming 75 percent currently drive alone to work).

Increasing participation to five days a week, would result in a five percent reduction. This impact to traffic congestion and air quality could be every bit as significant as traditional transit and ridesharing projects on a regional basis. Areas such as eastern Massachusetts, southern New Hampshire and Connecticut are most likely to be the centers of telecommuting activity and thus the prime benefactors through pollutant and congestion reduction. Targeting these areas for further telecommuting pilot programs, such as the one currently being done in Massachusetts, would provide more data on the advantages and disadvantages.

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Tables

Table 6.1 National Travel Statistics

	1969	1983	1990
Average Persons/Household	3.15	2.68	2.56
Workers per Household			
Male	0.77	0.69	0.69
Female	0.44	0.52	0.58
Total	1.21	1.21	1.27
Licensed Drivers/Household	1.65	1.72	1.75
Vehicles/Household	1.16	1.68	1.77
Annual Household Vehicle Trips	1,348	1,486	1,702
Average Trip Length to Work in Miles (All Modes)	NA	6.1	7.7
Purpose of Person Trips			
Earn a Living			21.6%
Family/Personal	NA	NA	41.5%
Civic/Education			11.4%
Social/Recreational			24.8%
Other			0.7%

Source: 1990 National Personal Transportation Survey, 1993, U.S. DOT.

Table 6.2 Census Data – New England States and USA

	Connecticut		New Hampshire		Massachusetts		New England		USA	
	1980	1990	1980	1990	1980	1990	1980	1990	1980	1990
Population (≥16 years old)	3,107,576	3,287,116	920,610	1,109,252	5,737,037	6,016,425	12,348,493	13,206,943	167,054,638	199,686,060
Workers	1,354,781	1,673,442	387,993	556,589	2,412,609	2,979,594	5,178,255	6,538,503	NA	NA
Population Distribution										
% Urban	79%	79%	52%	51%	84%	84%	75%	74%	74%	72%
% Rural	21%	21%	48%	49%	16%	16%	25%	26%	26%	28%
Persons in Household										
1	21%	24%	21%	22%	24%	26%	23%	24%	23%	25%
2	31%	32%	32%	34%	30%	31%	31%	33%	31%	32%
3	18%	18%	17%	18%	17%	18%	17%	18%	17%	17%
4 or More	39%	25%	30%	26%	29%	25%	29%	25%	29%	26%
Mode to Work										
Drive	56%	78%	64%	79%	62%	73%	60%	76%	66%	76%
Carpool	33%	11%	25%	12%	19%	11%	21%	11%	20%	12%
Transit	5%	4%	1%	1%	9%	8%	6%	5%	6%	5%
Walk	5%	4%	8%	4%	8%	5%	8%	5%	6%	4%
Work at Home	1%	3%	2%	4%	2%	3%	5%	3%	2%	3%
Of Those Who Drive to Work										
Drive Alone	63%	87%	72%	86%	76%	87%	73%	87%	77%	86%
2	27%	10%	20%	11%	17%	11%	19%	11%	16%	14%(>2)
3	6%	1%	5%	1%	4%	1%	5%	1%	4%	
4	3%	1%	2%	1%	2%	1%	2%	<1%	2%	
5 or More	2%	1%	1%	1%	1%	<1%	1%	<1%	1%	
Workers in Family										
None	11%	11%	10%	10%	12%	12%	12%	12%	13%	13%
1	31%	31%	29%	29%	30%	30%	30%	30%	33%	33%
2	42%	42%	46%	46%	41%	41%	41%	41%	42%	42%
3 or More	16%	16%	15%	15%	17%	17%	17%	17%	12%	12%

Table 6.2 Census Data – New England States and USA (continued)

	Maine		Rhode Island		Vermont		New England		USA	
	1980	1990	1980	1990	1980	1990	1980	1990	1980	1990
Population (≥16 years old)	1,124,660	1,227,928	947,154	1,003,464	511,456	562,758	12,348,493	13,206,943	167,054,638	199,686,060
Workers	428,318	570,883	385,668	481,230	208,886	276,765	5,178,255	6,538,503	NA	NA
Population Distribution										
% Urban	47%	45%	87%	86%	33%	32%	75%	74%	73%	72%
% Rural	53%	55%	13%	14%	67%	68%	25%	26%	26%	28%
Persons in Household										
1	21%	23%	24%	26%	22%	23%	23%	24%	23%	25%
2	32%	34%	31%	31%	31%	34%	31%	33%	31%	32%
3	17%	18%	17%	18%	17%	18%	17%	18%	17%	17%
4 or More	29%	25%	28%	24%	29%	25%	29%	25%	29%	26%
Mode to Work										
Drive	61%	76%	66%	78%	58%	74%	60%	76%	66%	76%
Carpool	25%	14%	22%	13%	25%	12%	21%	11%	20%	12%
Transit	2%	1%	4%	3%	1%	1%	6%	5%	6%	5%
Walk	9%	5%	7%	4%	11%	7%	8%	5%	6%	4%
Work at Home	3%	4%	1%	2%	5%	6%	5%	3%	2%	3%
Of Those Who Drive to Work										
Drive Alone	71%	84%	75%	86%	69%	85%	73%	87%	77%	86%
2	20%	13%	17%	11%	22%	13%	19%	11%	16%	14%(>2)
3	5%	2%	4%	2%	5%	1%	5%	1%	4%	
4	2%	1%	2%	<1%	2%	<1%	2%	<1%	2%	
5 or More	2%	<1%	1%	<1%	2%	<1%	1%	<1%	1%	
Workers in Family										
None	13%	13%	13%	13%	11%	11%	12%	12%	13%	13%
1	32%	32%	29%	29%	31%	31%	30%	30%	33%	33%
2	43%	43%	41%	41%	60% (≥2)	60%(≥2)	41%	41%	42%	42%
3 or More	12%	12%	16%	16%	NA	NA	17%	17%	12%	12%

Source: U.S. Department of Commerce, Bureau of the Census, 1980 and 1990.

Table 6.3 Census Data – Urban Areas within New England

	Stamford, CT		Portsmouth/Dover and Rochester, NH		Boston, MA	
	1980	1990	1980	1990	1980	1990
Workers	102,769	106,174	72,098	115,554	1,299,654	1,619,891
Male	56%	54%	58%	NA	56%	53%
Female	44%	46%	42%		44%	47%
Mode to Work						
Drive Alone	70%	68%	57%	76%	56%	60%
Carpool	19%	8%	28%	13%	18%	9%
Transit	4%	14%	2%	1%	15%	13%
Other	5%	5%	10%	6%	10%	16%
Work at Home	2%	5%	3%	4%	1%	2%
Average Auto Occupancy (Drive to Work)	1.14	1.06	1.24	1.09	1.16	1.08
Mean Travel Time to Work (Minutes)	23.1	24.2	18.6	20.8	25	24.5

	Bangor, ME		Providence, RI		Burlington, VT	
	1980	1990	1980	1990	1980	1990
Workers	38,689	42,722	370,557	544,688	53,210	75,728
Male	56%	52%	54%	53%	57%	53%
Female	44%	48%	46%	47%	43%	47%
Mode to Work						
Drive Alone	62%	76%	66%	79%	55%	68%
Carpool	20%	12%	20%	12%	27%	12%
Transit	2%	1%	4%	3%	3%	2%
Other	3%	8%	8%	4%	13%	15%
Work at Home	3%	3%	1%	2%	2%	3%
Average Auto Occupancy (Drive to Work)	1.15	1.08	1.15	1.08	1.23	1.08
Mean Travel Time to Work (Minutes)	16.6	16.1	17.4	19.7	19.6	17.3

Source: U.S. Department of Commerce, Bureau of the Census, 1980 and 1990.

7.0 Economics

7.0 Economics

7.1 Key Focus and Issues

The main focus of the forecast of the New England economy to 2010 was to provide general indicators to be used in planning for the region's future transportation needs. The key indicators that are discussed in this chapter and their annual rates of growth in the New England region are:

Indicator	Annual Average Rate of Growth in New England 1990-2010
Population	0.4%
Employment	0.7%
Gross Regional Product	1.9%
Personal Income	1.2%

Data is presented for New England, each of the six states and summary data for the metropolitan economic areas. More detailed information is also provided for economic sectors, such as manufacturing, trade, services, tourism and other activities.

Background historical information and general forecasts to 2040 were presented in the Phase I Inventory Report. Included were past trends in employment, unemployment, gross regional product (GRP), income, trade and other economic sectors. The recent economic recession and its implications for changes in the economic structure of the region was discussed. Most of this information is not repeated in this chapter, although a few of the relevant maps and revised tables have been included.

Some of the key implications of the forecasts that are relevant to planning for the transportation needs of the region include:

- The region's growth will generate increasing demand for the movement of passengers and cargo over its transportation networks. Between 1990 and 2010:
    - Population in the region will increase by about 1.1 million people (by almost nine percent);
    - Employment in the region will increase by about 1.0 million jobs (by 15 percent);
    - Gross regional product in the region will increase by $145 billion (in constant 1991 dollars), which is an increase of nearly 47 percent; and

- Personal income of people living in the region will increase by $72 billion (in constant 1991 dollars), which is an increase of nearly 27 percent.

- Increasing trade and competition with other regions of the nation and with international trade blocs will require:

  - Improved transportation service with other regions and international destinations; and

  - More rapid and efficient transportation of people and goods within the region.

- Transportation demand for moving goods and people will change in response to changes in the region's economy away from basic manufacturing and toward services and high tech activities. Some specific changes that will occur are that:

  - Demand for moving goods manufactured in the region by rail and truck will grow less rapidly than during the past decade;

  - Demand will increase for fast and efficient movement of high tech goods within the region, especially among clusters of growth activities;

  - Demand to move goods to and from national and international markets will increase;

  - Demand for fast and efficient business travel, especially of those engaged in knowledge-based industries will increase substantially;

  - Demand will increase for moving larger volumes of wholesale and retail goods to meet the needs of the growing population and income in the region;

  - Demand for increased recreation and pleasure travel to tourist destinations in the region will continue to increase rapidly; and

  - Demand will continue to increase for the transportation of goods such as construction materials, wood products and agricultural commodities.

- Faster and more efficient transportation will be required to meet the newly emerging logistics requirements of shippers and receivers. Meeting their needs is vital to the region's economic recovery and long-term growth. This will require improvements in the region's transportation network, especially in services and infrastructure.

7.2 Methodology

The same basic sources were used in this report as in the Inventory Report. Short-term forecasts of employment and population are based on those prepared by the New England Economic Project (NEEP) for the period to 1997. More detailed data is from New England Power Planning's (NEPOOL) reports which are also based on NEEP forecasts. Longer term forecasts to 2010 rely partly on the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) forecasts.

Officials in all New England states were interviewed about population and economic growth trends. Supplementary information from their forecasts of population and economic growth were taken into account. However, because of different base years, assumptions, methodologies, forecast years and levels of detail, it was more appropriate to use the NEEP forecasts.

Special information was obtained from other sources. This included data about trade flows which was obtained from the Massachusetts Institute for Social and Economic Research (MISER). Population forecasts for states which were prepared by the U.S. Bureau of the Census were reviewed. Special studies and forecasts of areas and economic sectors were taken into consideration. Strategies for achieving economic growth, as described in the Massachusetts report, "Choosing to Compete, a Statewide Strategy for Job Creation and Economic Growth," were reviewed.

The specific methodology followed in making the basic forecasts was to use the 1993 NEEP and NEPOOL forecasts for the period 1992-1997 and to rely on the NEPOOL forecasts alone for 1997 to 2007. These were extended to 2010 based on the BEA long-term growth rates for the 2005 to 2010 period. This approach was followed because the NEEP forecast is more accurate than NEPOOL's for the short term and because NEPOOL's updated forecast is not yet available. NEPOOL's forecast for the 1997 to 2007 period more closely reflects recent economic conditions and the specific structure of the New England economy than does BEA's more general long-term forecast. The longer-term forecasts of BEA have conservative growth rates.

The economic forecasts should be considered as generally indicating the order of magnitude of growth that is likely to occur in New England and in its constituent jurisdictions. Experience shows that some sectors of the economy will grow faster than forecast and others will grow slower. Currently, updated economic forecasts are being prepared by NEEP and by NEPOOL, which will provide more accurate forecasts for the region. These will be incorporated in the study when they become available later this spring.

The population forecasts are also based on NEEP and NEPOOL information, as well as supplementary data from BEA and the U.S. Census. NEEP, NEPOOL and BEA balance their forecasts of population growth with employment opportunities. Essentially, this is done by adjusting the rate of net migration into and out of New England and its constituent states.

The U.S. Bureau of the Census is currently completing its first updated forecast of population for states using 1990 Census data. This forecast is expected to be available later in the spring. It will provide overall population estimates, as well as information about age and sex distributions. The currently available U.S. Census projections for states were made before the 1990 Census. Significant adjustments in assumptions about fertility rates, immigration and mortality have been incorporated in the new forecast. Until this standard forecast becomes available, the population forecasts in this chapter should be considered as providing order of magnitude estimates for planning purposes.

7.3 Forecast Results

The amount, total and annual rate of growth for four economic indicators are summarized in Table 7.1 for both the region and for the United States. The results indicate that the region will grow about three-fourths as fast as the nation.

The population in New England is forecast by the U.S. Census to grow from 13.1 million in 1990 to about 14.2 million in 2010, which is an increase of 8.7 percent (see Table 7.1). This is a total increase of about 1.1 million persons. This increase is greater than the total population of Vermont and of Rhode Island. It is almost as much as the total population of New Hampshire in 1990.

Employment in New England is forecast to increase from 6.7 million in 1990 to about 7.7 million in 2010, which is an increase of 15.4 percent (see Table 7.1). Part of the reason for the increase in employment is because the base year, 1990, was during a recession. The total increase in employment is more than one million jobs, which is more than the employment in four of the six New England states.

Gross regional product (the total value of goods and services produced in the region) will increase by about 47 percent between 1990 and 2010, growing from about $310 billion in 1990 to $456 billion in 2010.

Personal income (the total amount of wages, salaries and other income) of people living in the region is forecast to increase by $72 billion. This is an increase of nearly 27 percent between 1990 and 2010. It is generated by the combination of a growing population and rising real per capita incomes.

7.3.1 Population

The population of New England is expected to increase by 8.7 percent during the 1990 to 2010 period. (See Table 7.2.) This compares with an increase of 11.5 percent during the previous two decades. The future growth rate is about three-fourths as rapid. Compared

with the United States, New England's population is expected to increase about two-thirds as fast through 2010.

There are substantial differences in the rate of population growth among the New England States. The northern three states, New Hampshire, Maine and Vermont are expected to grow by between 15 and 33 percent during the next two decades. The southern three states (Massachusetts, Connecticut and Rhode Island) are expected to grow by between one and eight percent.

The increase in numbers of people shows a somewhat different pattern. The largest numerical increase in population (more than 380,000) is expected to occur in New Hampshire; the second largest increase (244,000) in Connecticut, and the third largest (219,000) in Maine. Vermont, Massachusetts and Rhode Island are each expected to add between 75,000 and 85,000 people.

The population of the metropolitan areas in New England is shown in Table 7.3. It indicates that overall, about three-fourths of the region's population lives in metropolitan areas. The most rapidly growing metropolitan areas include: Portsmouth, NH, Burlington, VT, Portland, ME and Worcester, MA.

The 1990 population density (persons per square mile) of each county in New England is shown in Figure 7.1. It indicates that high densities are found around Boston, Providence, Springfield, Hartford and in southwestern Connecticut. There is also high density along the southern Maine Coast, southern New Hampshire and southern and central Vermont. The projected change in population density is shown in Figure 7.2. It indicates that population is becoming more decentralized. While most of the increase occurs in and around existing population centers, densities are expected to increase in central New Hampshire, near the Maine coast north of Portland toward Lewiston and Rockland, west of I-495 in Massachusetts, and in Connecticut especially east of I-91. The decentralization of population will place burdens on the transportation infrastructure needed to serve these outlying areas.

7.3.2 Employment

Employment by Area

Employment in New England is expected to increase by 15.5 percent during the 1990 to 2010 period. (See Table 7.4.) This compares with an increase of more than 50 percent during the previous two decades, especially during the "booming" 1980s. The future growth rate is about one-third as rapid. Employment in New England is expected to grow about 70 percent as fast as in the nation.

New Hampshire, with a 20 percent increase in employment during the 1990 to 2010 period, has the largest growth among the New England states. Vermont is expected to be second with an increase of 16.5 percent. At the other end of the range, Connecticut is expected to have the smallest amount of growth, 13.5 percent.

The increase in employment by state is shown in Table 7.4. It indicates that most job increases will be in the larger states, although their growth rates are slower. Massachusetts and Connecticut are expected to account for more than 70 percent of the total increase in employment in New England. This means that much of the increase in business demand for transportation will occur in southern New England. However, the percent increase indicates that proportionally larger increases will be placed on the transportation infrastructure in the northern New England states, especially in New Hampshire.

The density of employment (number of employees per square mile) in 1990 is shown for each county in New England in Figure 7.3. It indicates that employment, like population is concentrated in the larger metropolitan areas and in major highway and rail corridors, such as I-95, I-495 in Massachusetts and I-91 in Connecticut. The change in density of employment between 1990 and 2010 is shown in Figure 7.4. It indicates an increase around major metropolitan areas and corridors; however, it also indicates continued decentralization. This is especially noticeable in southern New Hampshire, Maine, Vermont and in areas west of I-495 in Massachusetts.

Employment by Economic Sector

Employment in economic sectors is shown in Figure 7.5 and in Table 7.5 for the year 2000. These indicate that nearly 39 percent of employment is in services (including finance, insurance and real estate) and an additional 14 percent is in government. Together, these sectors account for 53 percent of employment in the region. These sectors (especially business services) generate a substantial number of business trips. The education component is associated with large numbers of trips by college students. The tourism component is a major generator (and attractor) of pleasure travelers.

The demand for goods movements is mainly generated by manufacturing (which accounts for 16 percent of employment), wholesale and retail trade (22.7 percent), construction (3.5 percent) and resource activities such as agriculture, forestry, mining and fishing (one percent). Altogether, these activities account for 47 percent of New England employment.

Table 7.5 shows that the largest growth in numbers of employees is the service sector. It accounts for more than two-thirds of the growth in all expanding sectors. Growth in this sector generates business and pleasure travel and demand for small package service. It generates relatively little heavy truck and rail freight demand. Manufacturing, which generates substantial demand for freight transportation by truck, rail and some ships is expected to decline in employment by nearly six percent. Goods movements are expected to increase slowly because increases in worker productivity will more than offset the effects of the decrease in employment. Growth will be slow and there will be a shift from heavier primary and secondary products to tertiary (intermediate products and components). These generally will be smaller, lighter and more valuable per pound.

The combined effect of the sizeable expansion of the service sector and the decline of manufacturing together with a shift toward smaller lighter goods means that:

- Demand for the transportation of manufactured goods and heavier primary inputs will grow slowly or decrease; and

- Demand for passenger transportation, for business and pleasure travelers, especially tourists will increase rapidly.

The trade sector will grow rapidly, accounting for more than one-fourth of the increase in employment in the growth sectors. This expansion will generate substantial demand for the transportation of merchandise, especially to wholesalers and distributors who, in turn, supply stores and restaurants.

The smallest sector, resource activities, is also the most rapidly expanding. However, many of the activities which it includes are very dependent on transportation services for moving commodities such as potatoes and fish, wood products and paper, and mineral products, including cement, granite, sand and gravel. The construction sector will continue to expand slowly generating increasing demand for the transportation of building materials and related products.

The growth in employment in all sectors will generate increased numbers of commuting trips by the growing numbers of workers and shoppers. Tourism and recreation are expected to generate a rapidly growing number of trips. Many of these will be destined for coastal and mountain recreation areas, as well as attractions such as conventions, sports, gambling and other venues. Tourist and pleasure travelers generate peak demand during certain seasons in particular areas and along specific routes. This places unusually heavy demands on certain parts of the region's transportation network.

Figures 7.6 through 7.12 summarize the forecasts of employment by major sector for the New England region and for individual states. These figures show the composition of employment and the rate of growth in each sector for each state.

7.3.3 Gross Regional Product

The gross regional product (GRP), which indicates the total value of goods and services produced in New England, is presented in Table 7.6. GRP is similar in concept to the nation's gross national product (GNP). This data is often used in models for forecasting transportation demand. Gross regional product is directly related to the output of the region's economic sectors. Employment, by comparison, indirectly indicates output because it must be adjusted to take into account changes in productivity. As productivity increases, more output (and larger volumes of goods) are produced by the same number of workers. Overall, productivity generally increases at an average annual rate of 0.5 to 1.0 percent annually. However, rates vary substantially among economic sectors and regions.

Table 7.6 indicates that gross regional product in the region is expected to increase at an average annual rate of 1.9 percent (in constant $1991) between 1990 and 2010. This is about 80 percent as fast as in the nation. In states such as New Hampshire, the rate will be significantly faster, averaging 2.5 percent. At the other end of the range are Connecticut, Rhode Island, and Massachusetts, whose GRP is expected to grow at an average annual rate of between 1.7 and 1.9 percent.

7.3.4 Personal Income

The forecast of personal income for New England and for each of its six sates is presented in Table 7.7. Personal income is the total amount of money received by people living in the region. It includes wages and salaries, unearned income and government transfers, such as social security. Personal income indicates how much money will be available for all forms of personal/household spending.

Growth in real (constant dollar) personal income indicates that larger amounts of retail goods, housing and services will be purchased. Expenditures will increase for tourism and recreation. There will also be greater capacity to pay for governmental services.

The forecast of personal income indicates that it will increase by nearly $82 billion (in constant $1991) between 1990 and 2010. This increase is about as much as total personal income was in Connecticut in 1990. Looked at another way, the increase is more than the combined total income of four states (Maine, New Hampshire, Vermont, and Rhode Island).

During the 1990 to 2010 period, personal income in the region is forecast to increase by a total of 26.8 percent, which is at an average annual rate of 1.2 percent. This is about three-fourths as fast as the national rate of increase of 1.6 percent. The increase in personal income is generated by the combined growth of population (and employment) and increase in real per capita incomes. Within the region, between 1990 and 2010, personal income in the northern states (Maine, New Hampshire, and Vermont) will increase between 41 and 58 percent, while in the southern three states (Massachusetts, Connecticut, and Rhode Island), it will increase between 19 and 30 percent.

7.4 Implications of the Economic Forecasts for the Region's Transportation Needs

Some of the implications of the economic forecasts for transportation needs in the New England region are outlined in this section. These include types of commodities, types of movements and linkages to certain economic sectors.

7.4.1 Freight Transportation

- **Types of commodities:**
    - More smaller, lighter goods with higher value per pound and comparatively less heavy manufactured goods, such as machinery;
    - More semi-finished goods used in assembly types of manufacturing;

- More wholesale and retail goods distribution, in response to increased retail sales generated by rising personal income; and

- Continued need to bring in raw materials in bulk (such as plastics and chemicals), and fuel (gasoline, petroleum, coal and natural gas).

- **Types of goods movements:**

  - New logistics networks will be implemented to meet the just-in-time and faster door-to-door goods movement requirements of manufacturers and retailers; improved transportation infrastructure and services will be needed to serve these systems;

  - Faster and easier movement of goods to and from national and international markets on which New England businesses will increasingly be needed; and

  - Faster and more efficient transportation of goods that are essential to the growth of "clusters" of economic activities that have good potential for growth, such as health-biotechnology, communications-computers, wood-paper specialty products, and similar clusters.

Internal transportation linkages within the region are key to realizing agglomeration economies and interindustry benefits essential to the growth of key "clusters" of economic activities.

7.4.2 Passenger Transportation

- **Economic sectors:**

  - Commuting trips to and from work and local shopping trips will increase in response to the growth in employment and expansion of retail trade. These trips will require continued upgrading of road and transit networks, especially in metropolitan areas;

  - The services and retail sectors will expand comparatively rapidly, resulting in an increase in intercity automobile and small truck movements, as well as local trips; and

  - Continued strong growth in the tourism sector will generate large volumes of tourism and recreation trips to recreational areas and attractions. Improvements to the regional road network and to routes linking the region with other states and with Canada will be needed to accommodate the increasing numbers of these trips.

- **Types of movements:**

  - Metropolitan road and transit networks will need to be improved so that shoppers, and persons employed in marketing and sales, professional and service workers can conduct their business efficiently;

  - National and international transportation service for business and professional travelers will need to be improved. Growth of the service sector requires frequent, fast and competitive transportation services to expand in growing national and international markets;

  - National and international transportation facilities and services for manufacturing, other goods producing and trade sectors will need to be improved to meet the dependence of New England business on national and international markets. Sales, marketing and administrative staffs of these businesses require frequent and efficient service to these growing market areas in order compete effectively; today between 10 and 12 percent of the New England economy is dependent on international trade. By 2010, this is likely to increase to between 15 and 25 percent;

  - Improved transportation within New England and between New England and other areas is essential to the continued growth of tourism. Tourism is increasingly dependent on attracting visitors from farther away, such as the New York-Washington, D.C. corridor, other regions of the United States, Canada, Mexico and overseas. Because vacation time is limited and conferences/conventions only last for a few days, frequent, fast and efficient transportation to and from attractions in New England is essential by road, air and rail.

7.5 Conclusion

Forecasts of economic growth are subject to many unanticipated events which lead to faster or slower actual growth. Currently, New England is going through a transition period and recovering from a severe recession. This and other external circumstances are causing a change in its economic structure, as discussed in the Inventory Report. However, the history of New England indicates that its economy is resilient and that the region will recover and resume its long-term pattern of growth.

7.5.1 Strengths of the New England Economy

The New England economy has substantial strengths that provide it with long-term competitive advantages over many other regions. Some of these strengths include:

- A large higher education sector including both technical and liberal arts colleges and universities, as well as many world-renowned research centers. Hundreds of companies in the fields of computers, electronics, optics, biomedicine, consulting, computer software, and specialized research centers have been established in New England by graduates of these universities.

- Entrepreneurial activity has been strong in New England for many generations and is continuing. Many new businesses are being established by former employees of research centers and high tech companies, as well as by graduates of local educational institutions.

  - Clusters of businesses that have good potential for growth have been identified in several states. These include such groups as health-medical research-biotechnology, electronic research-computers-communications and new materials research-new product development businesses.

  - Growth is continuing in some well-established sectors of the economy, such as in health care, some financial services, some specialized computer and software production, business services, and tourism.

- Growth is beginning to resume in some companies that have successfully restructured. These include businesses that have "down-sized," reorganized, or have successfully made the transition from producing goods for defense to producing goods for commercial markets, especially in the electronics, instrument and optical fields.

- Strong, long-term international relationships, especially with Europe and Canada make it easier for some New England businesses to expand internationally. These relationships are reinforced by the large numbers of foreign visitors, students and foreign travel by New Englanders. There is potential for the business community, including banking, to build on its good international relationships and to expand more rapidly in the future.

7.5.2 Importance of a Good Transportation Network to the New England Economy

A good regional transportation network will play critical role in the resurgence of the New England economy.

A good **intraregional** transportation network will specifically benefit the following sectors of the New England economy:

- The clusters of growth industries – by facilitating fast and efficient transportation between related businesses that comprise these clusters;

- Reduce transportation/logistics costs of New England businesses and services; and

- Facilitate the expansion of tourism and recreation.

A good **interregional** and **intraregional** transportation network and service will:

- Help the increasingly large proportion of businesses and services dependent on growing national and international markets to compete effectively in these markets. New England is farther from the most rapidly growing regions in the United States than other locations and it is essential to offset part of the cost and time disadvantages that it faces in serving these markets.

- Help meet the increasingly stringent long-distance transportation requirements of customers. This means delivering goods faster, more efficiently, at specified delivery times and with increased reliability. This places new burdens on all modes of transportation.

- Facilitate the expansion of high tech, service and tourism sectors, towards which the New England economy is shifting. These are dependent on fast, reliable and efficient transportation of goods and people between the regional and growing world markets.

A good transportation network serving New England is essential to the successful revitalization of its economy. It will improve the efficiency of transportation within and to and from the region. This will help New England to become more competitive with other areas, to lower costs, improve transportation service, and improve the quality of life for people living in the region.

Tables

Table 7.1 Projected Growth in the New England Region Population, Employment, Gross Regional Product and Personal Income, 1990-2010

	New England Region			United Sates
	Numerical Increase	Total Percent Increase	Annual Average Rate of Growth	Annual Average Rate of Growth
Population	1.1 Million	8.7%	0.4%	0.6%
Employment	1.0 Million	15.4	0.7	1.0
Gross Regional Product (in $1991)	1.80 Billion	58.8	2.3	2.4
Personal Income	7.2 Billion	26.8	1.2	1.6

Table 7.2 Population Projections for New England and the Six States, 1990-2010 (Numbers in Thousands)

						1990-2010		
						Percent Growth		Numerical
State	1990	1995	2000	2005	2010	Annual	Total	Increase
Connecticut	3,271	3,363	3,432	3,479	3,515	0.4%	7.5%	244
Massachusetts	5,903	5,939	5,959	5,971	5,985	0.1	1.4	82
Rhode Island	1,003	1,027	1,046	1,062	1,078	0.4	7.5	7.5
Maine	1,234	1,301	1,359	1,409	1,453	0.8	17.8	219
New Hampshire	1,143	1,270	1,373	1,456	1,525	1.5	33.4	382
Vermont	569	597	619	637	654	0.7	14.9	85
Total	**13,072**	**13,497**	**13,788**	**14,014**	**14,210**	**0.4%**	**8.7%**	**1,138**

Source: U.S. Bureau of the Census, Series P-25 (1990).

Table 7.3 Population of Metropolitan Areas in New England, 1990-2010 (Numbers in Thousands)

Metropolitan Area	1990	1995	2000	2005	2010	Average Annual Rate of Growth 1990-2010
Bridgeport-Stamford-Norwalk-Danbury, CT	828	854	876	897	917	0.5%
Hartford-New Britain-Middletown-Bristol, CT	1,124	1,165	1,200	1,233	1,264	0.6
New Haven-Waterbury-Meriden, CT	806	837	863	886	908	0.6
Bangor, ME	149	147	151	154	157	0.5
Lewiston-Auburn, ME	104	108	111	114	117	0.6
Portland, ME	240	251	201	269	277	0.7
Boston-Lawrence-Salem-Lowell-Brockton, MA	3,784	3,904	4,009	4,111	4,208	0.5
New Bedford-Fall River-Attleboro, MA	490	506	522	537	552	0.6
Worcester-Fitchburg-Leominster, MA	686	712	796	759	781	0.7
Springfield, MA	599	617	633	648	663	0.5
Pittsfield, MA	140	143	146	149	151	0.4
Portsmouth-Dover-Rochester, NH	342	363	381	397	412	0.9
Providence-Pawtucket-Woonsocket, RI	921	952	981	1,008	1,084	0.6
Burlington, VT	138	146	152	158	164	0.9
	10,345	10,705	11,022	11,320	11,605	

Source: BEA Regional Projections to 2040 and Cambridge Systematics, Inc.

Table 7.4 Employment Projections for New England by State, 1990-2010 (Numbers in Thousands)

State	1990	2010	1990-2010 Percent Growth	1990-2010 Numerical Change
Connecticut*	1,728	1,961	13.5%	233
Massachusetts	3,136	3,626	15.6	490
Rhode Island	474	545	15.0	71
Maine	565	650	15.0	85
New Hampshire	536	643	20.0	107
Vermont	272	317	16.5	45
Total	**6,711**	**7,742**	**15.4%**	**1,031**

* Alternate data provided by Connecticut DOT:
1990 - 1,678
2010 - 1,812
Growth - 8.0%
Change - 134

Employment forecasts vary by source, assumptions, and time of completion. For consistency, U.S. Department of Commerce, Bureau of Economic Analysis, official forecasts were used.

Source: NEPLAN data through 1997; BEA growth rates used to extend forecasts for 1997 to 2010.

Table 7.5 Employment Projections for New England by Economic Sector, 1990-2010 (Numbers in Thousands)

State	1990	2010	1990-2010 Percent Growth	1990-2010 Numerical Change
Agriculture, Forestry, Fisheries, Mining	42	59	40.5%	17
Construction	255	263	3.1	8
Manufacturing	1,223	1,150	-6.0	-73
Transportation and Public Utilities	270	269	0.0	-1
Trade	1,515	1,799	18.8	284
Services	2,407	3,150	30.9	743
Government	999	1,052	5.3	53
Total	**6,711**	**7,742**	**15.4%**	**1,031**

Note: Government employment is from BEA.

Source: NEPLAN data through 1997; BEA growth rates used to extend forecasts for 1997 to 2010.

Table 7.6 Gross Regional Product in New England, 1990-2020

State	1990	1995	2000	2005	2010	1990-2010 Annual	1990-2010 Total
Connecticut	88,778	93,442	103,875	114,126	124,162	1.7%	39.9%
Massachusetts	141,614	151,892	172,052	189,030	205,653	1.9	45.2
Rhode Island	18,955	19,868	22,878	25,633	28,440	2.0	50.0
Maine	22,938	25,282	28,923	32,565	36,486	2.3	59.1
New Hampshire	25,541	29,131	33,522	37,558	41,876	2.5	64.0
Vermont	12,318	13,100	14,899	16,856	18,979	2.2	54.1
Total	310,144	332,714	376,149	415,768	455,595	1.9	46.9

Note: Data for 2000 was estimated on NEEP forecasts; it was extended to 2010 based on NEPOOL Growth Rates.

Source: NEPLAN and NEPOOL.

Table 7.7 Total Personal Income in New England, 1990-2010 (In Millions of $1991)

State	1990	1995	2000	2005	2010	1990-2010	
						Annual	Total
Connecticut	86,541	92,866	99,123	103,378	107,682	1.1%	24.4%
Massachusetts	141,542	149,081	156,597	162,035	167,712	0.9	18.5
Rhode Island	19,578	21,217	22,872	24,123	25,438	1.3	29.9
Maine	21,569	24,141	26,772	28,976	31,193	1.9	44.6
New Hampshire	25,322	29,531	33,572	36,795	39,902	2.3	57.6
Vermont	10,091	11,230	12,350	13,257	14,198	1.7	40.7
New England	**304,643**	**328,066**	**351,226**	**368,564**	**386,125**	**1.2%**	**26.8%**

Source: U.S. Bureau of Economic Analysis and Cambridge Systematics, Inc.

Figures

Figure 7.1 Population Density by County, 1990 with NHS Highways
(People per Square Mile)

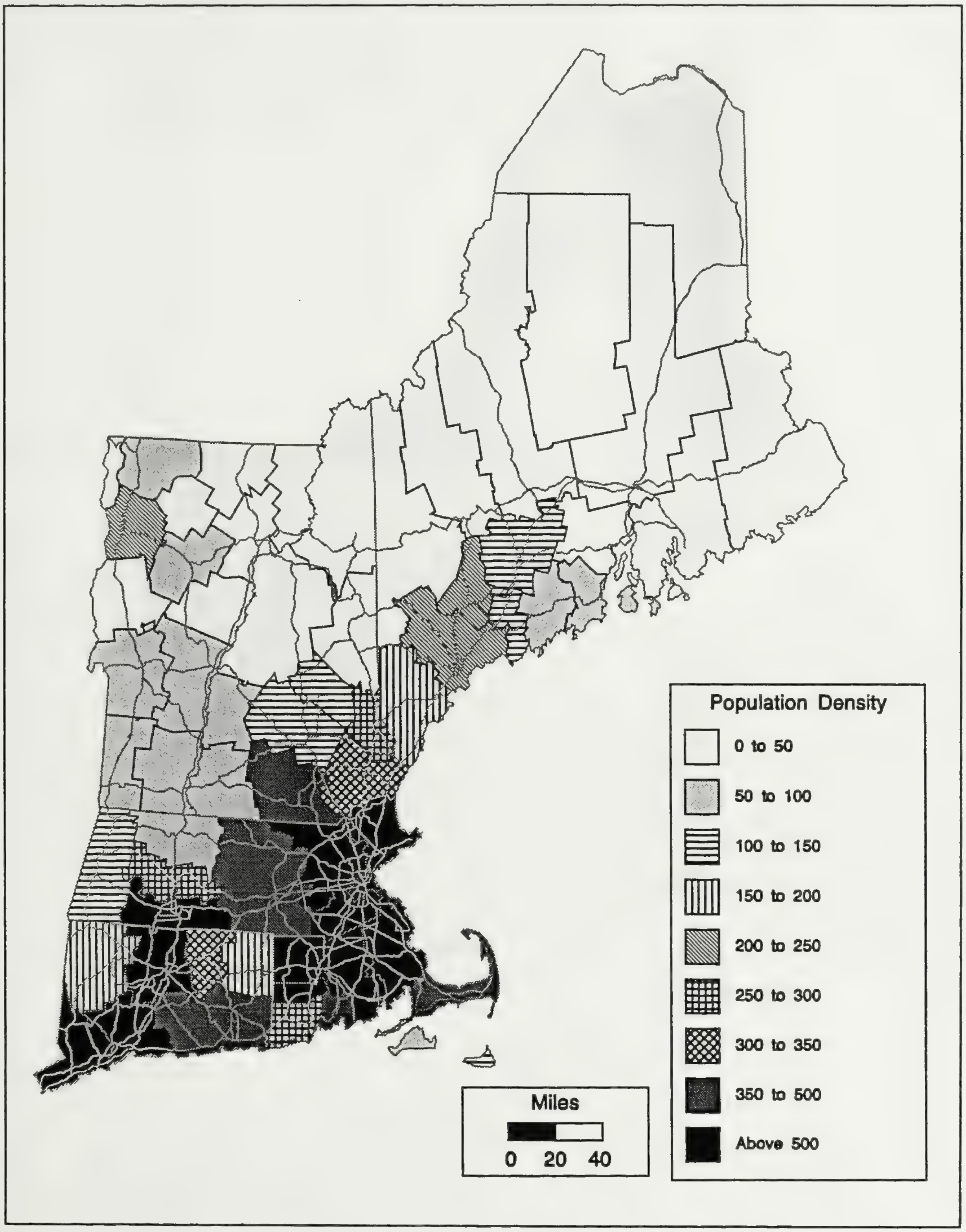


Figure 7.2 Change in Population Density by County, 1990-2020
(People per Square Mile)

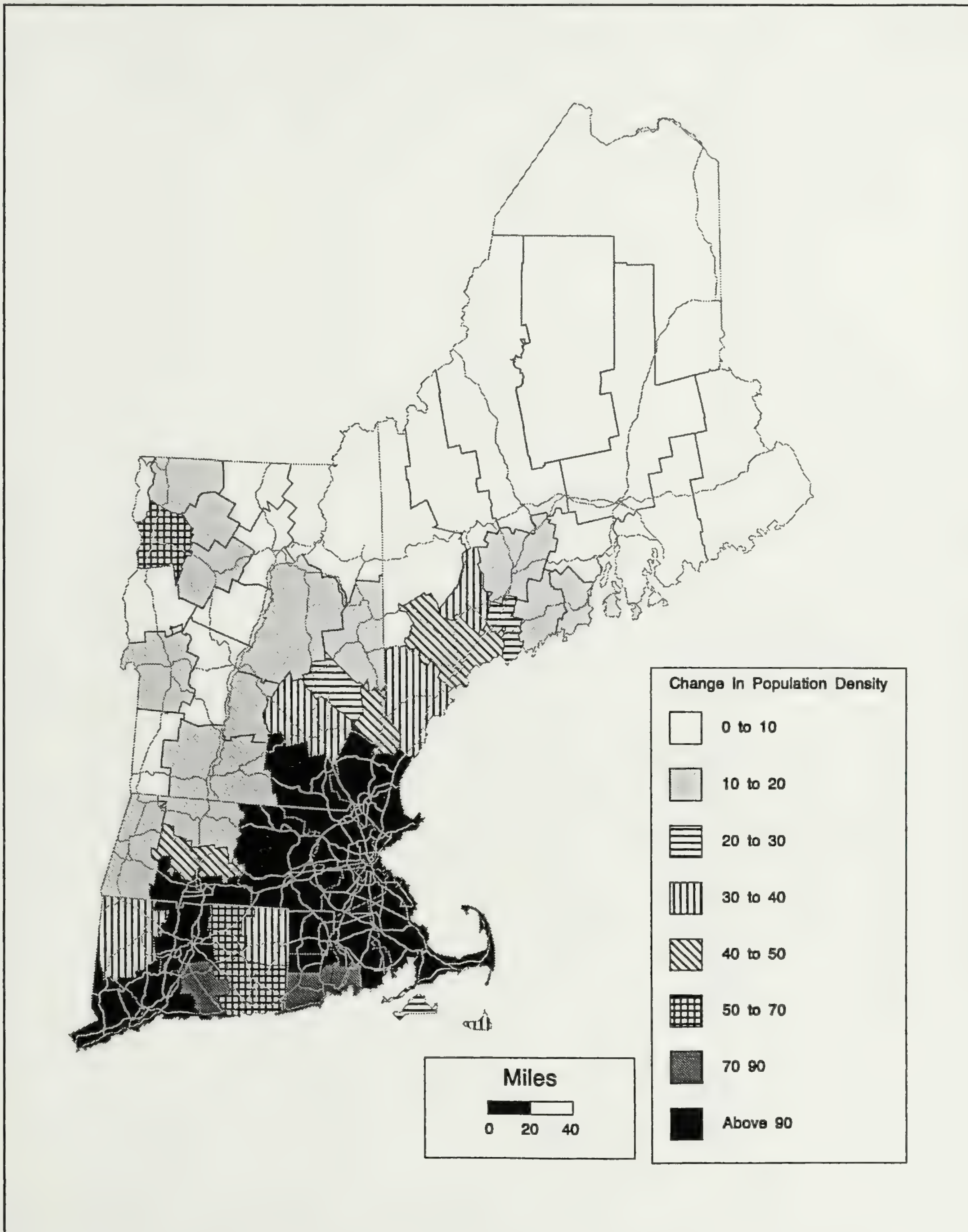


Figure 7.3 Employment Density by County, 1990
(Employees per Square Mile)

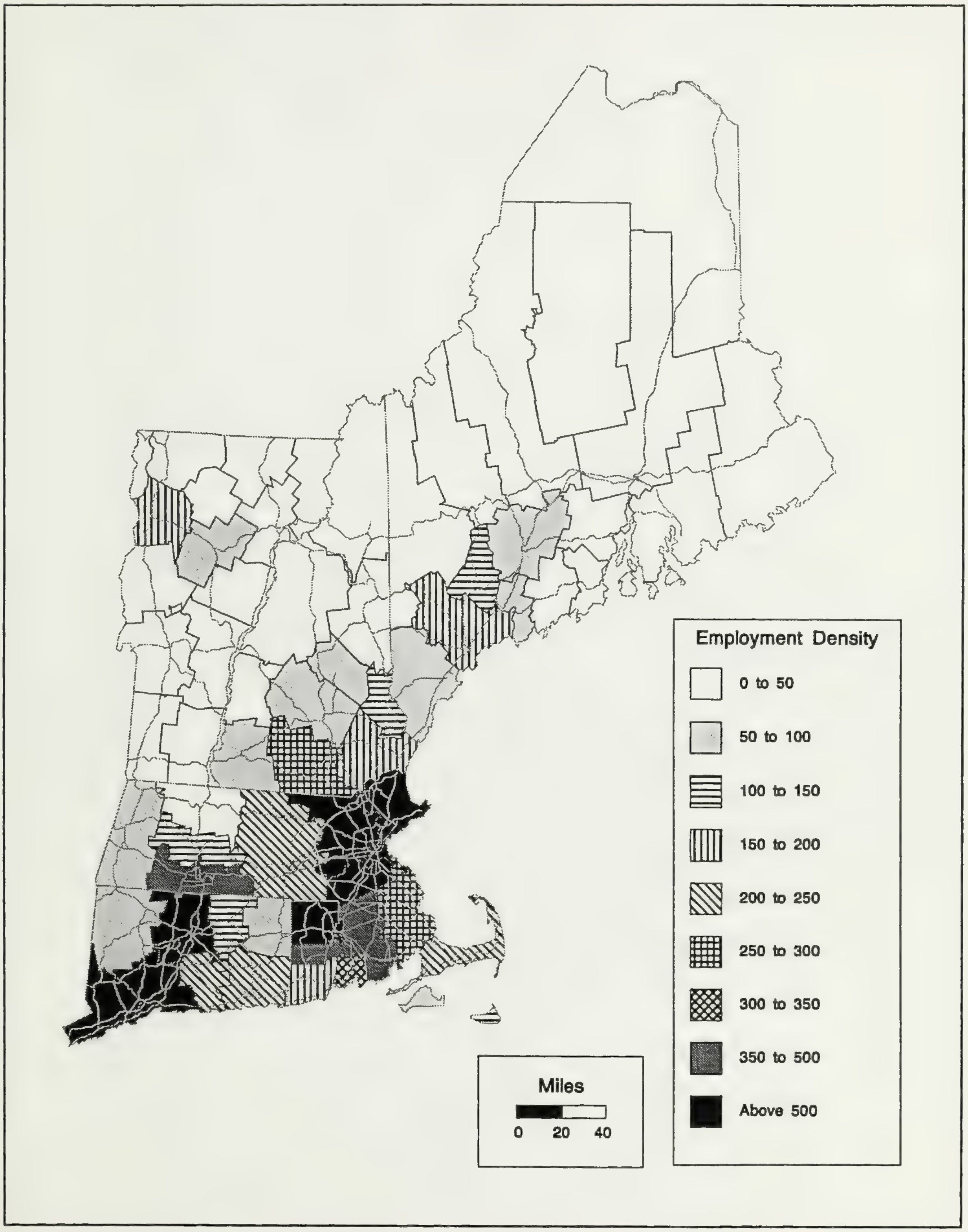


Figure 7.4 Absolute Change in Employment by County, 1990-2020
(Number of Jobs per Square Mile)

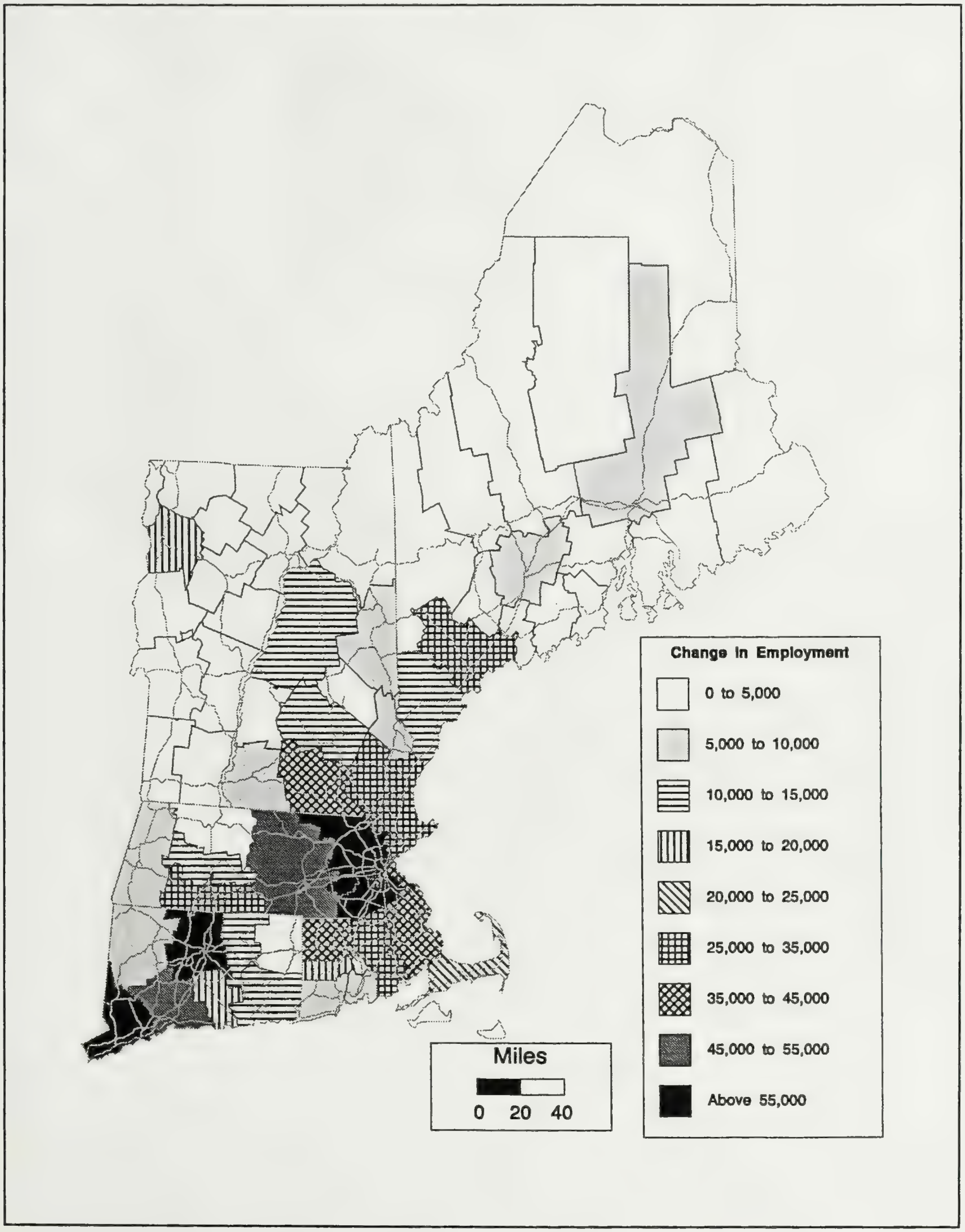


Figure 7.5 Percentage Composition of Employment in New England, Year 2000

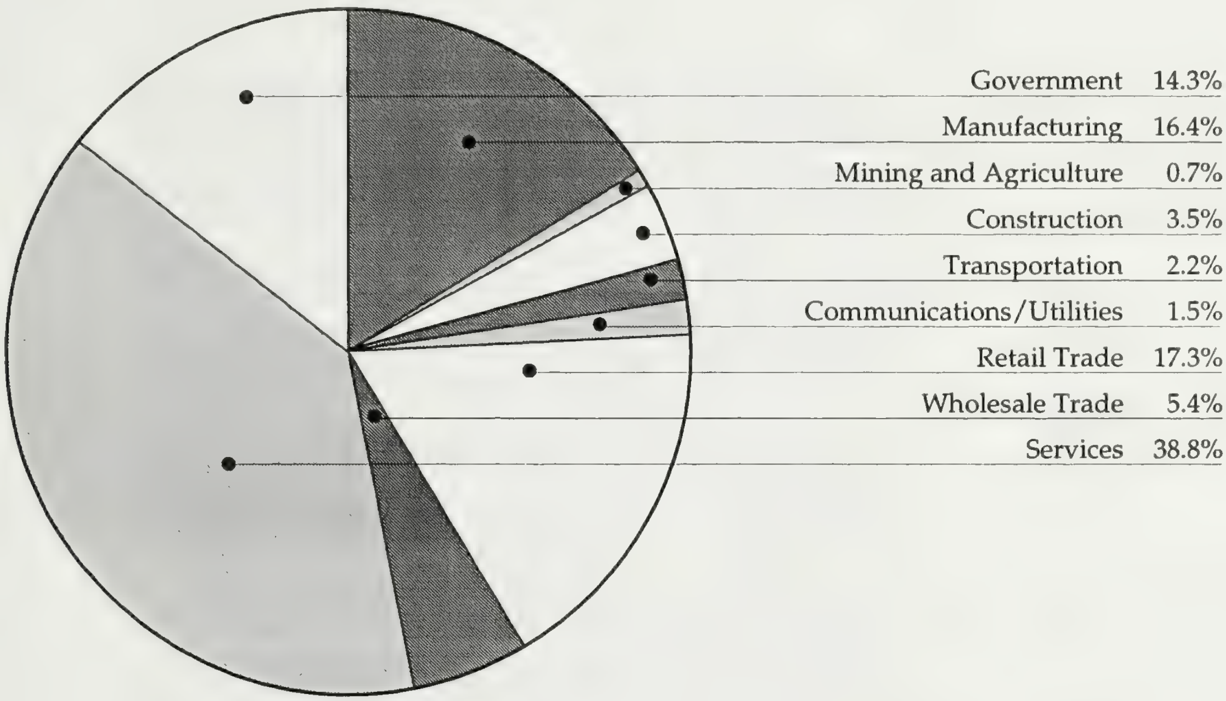


Figure 7.6 New England Employment Forecast, 1986-2010

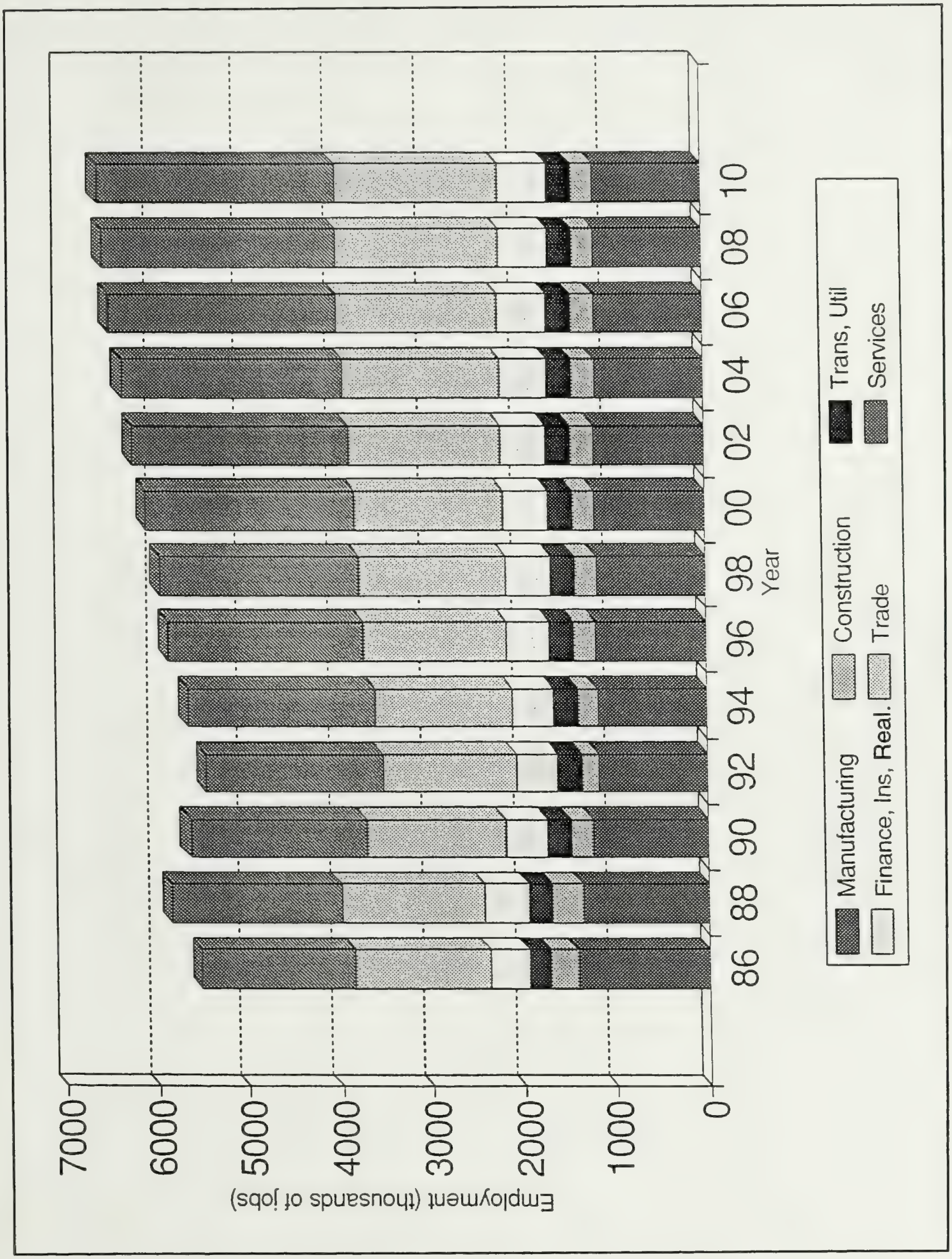


Figure 7.7 Connecticut Employment Forecast, 1986-2010

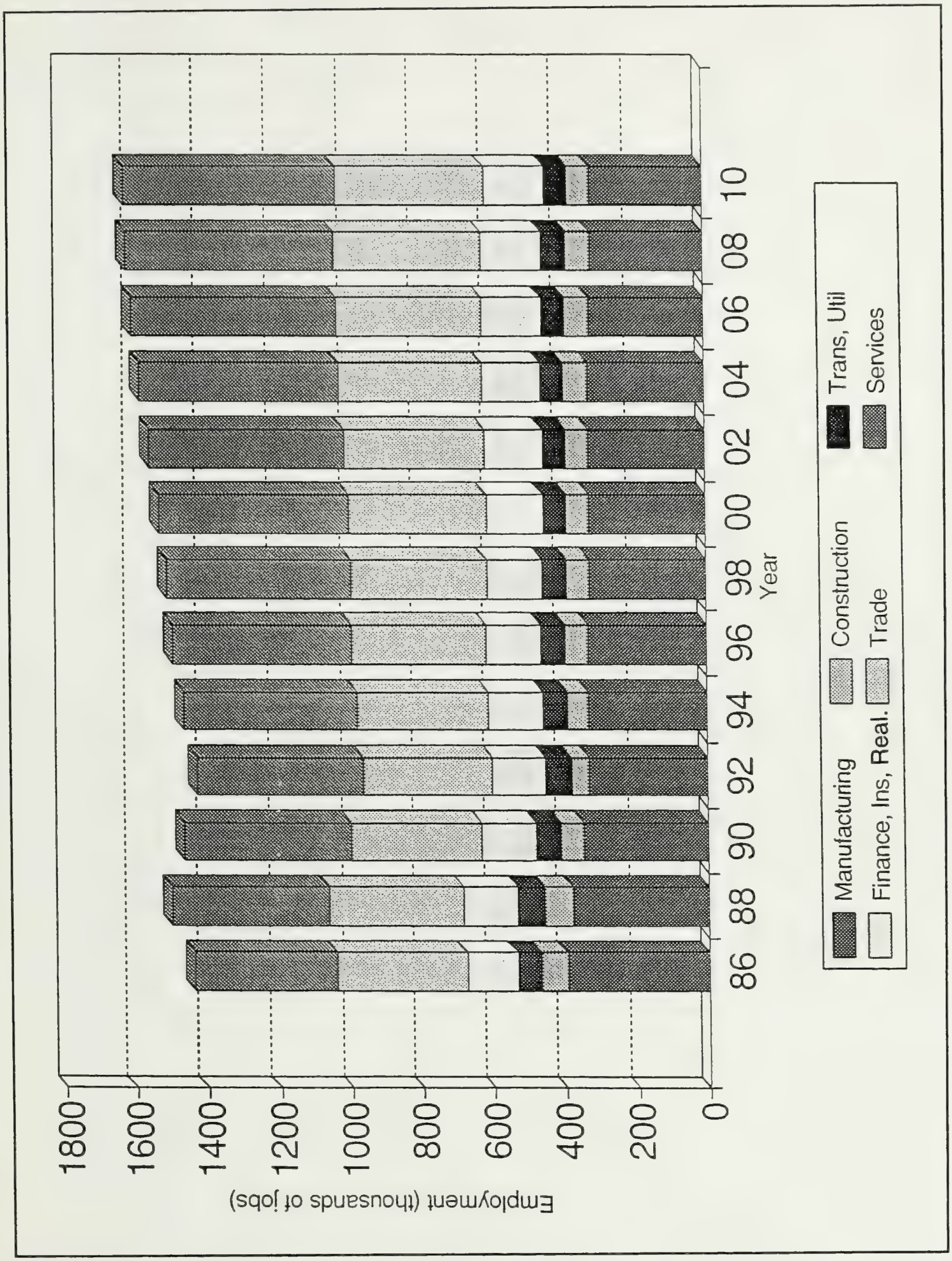


Figure 7.8 Massachusetts Employment Forecast, 1986-2010

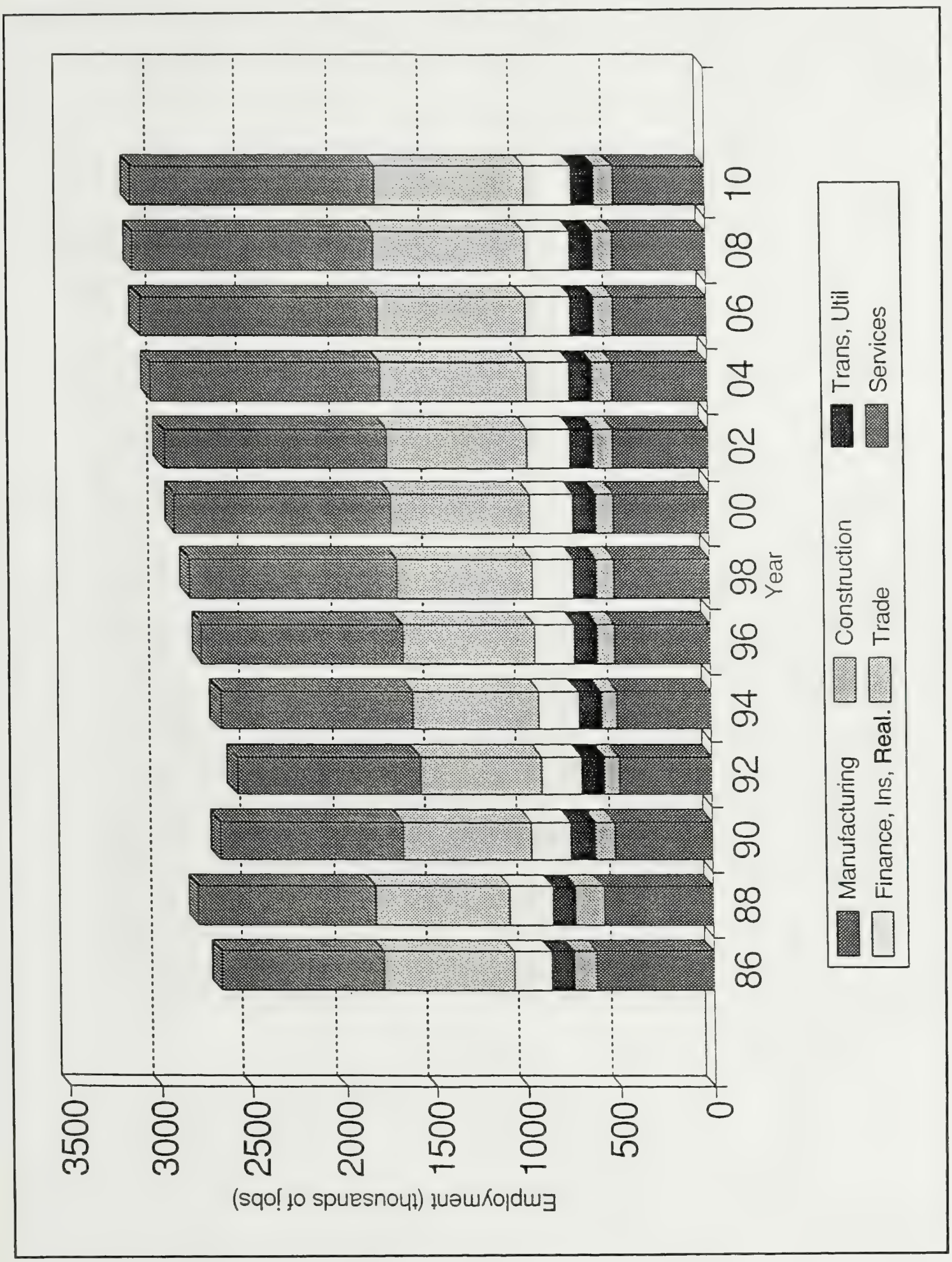


Figure 7.9 Rhode Island Employment Forecast, 1986-2010

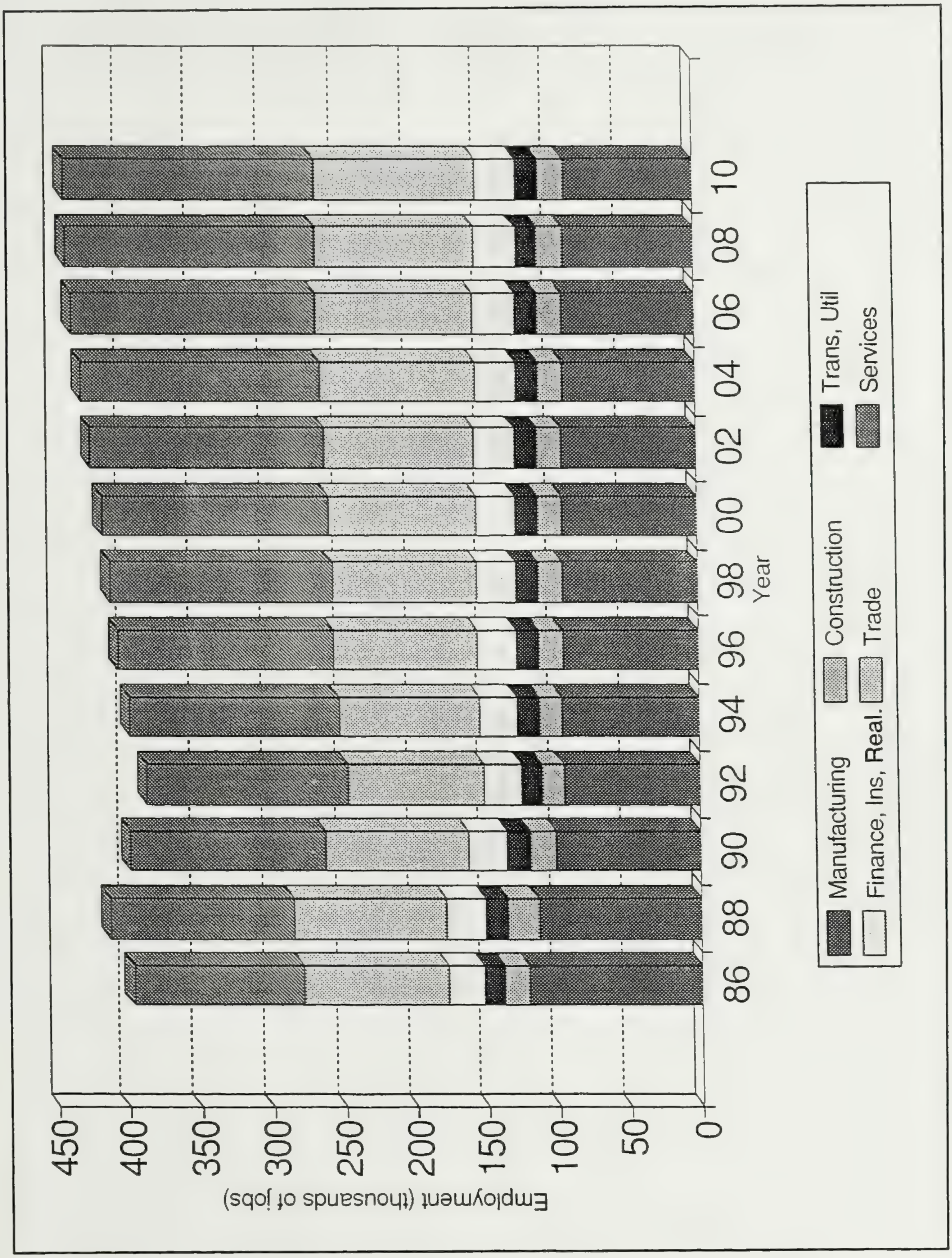


Figure 7.10 Maine Employment Forecast, 1986-2010

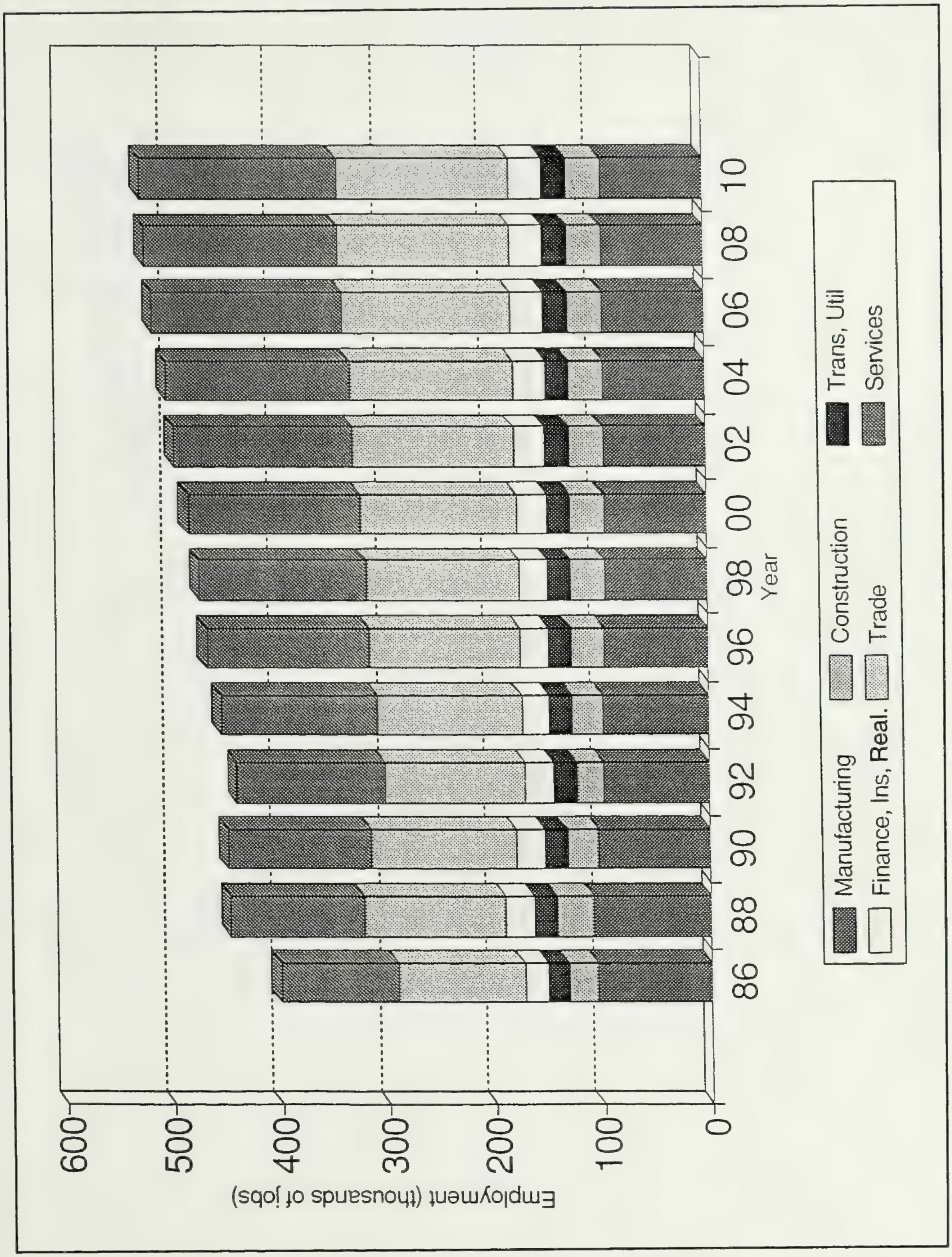


Figure 7.11 New Hampshire Employment Forecast, 1986-2010

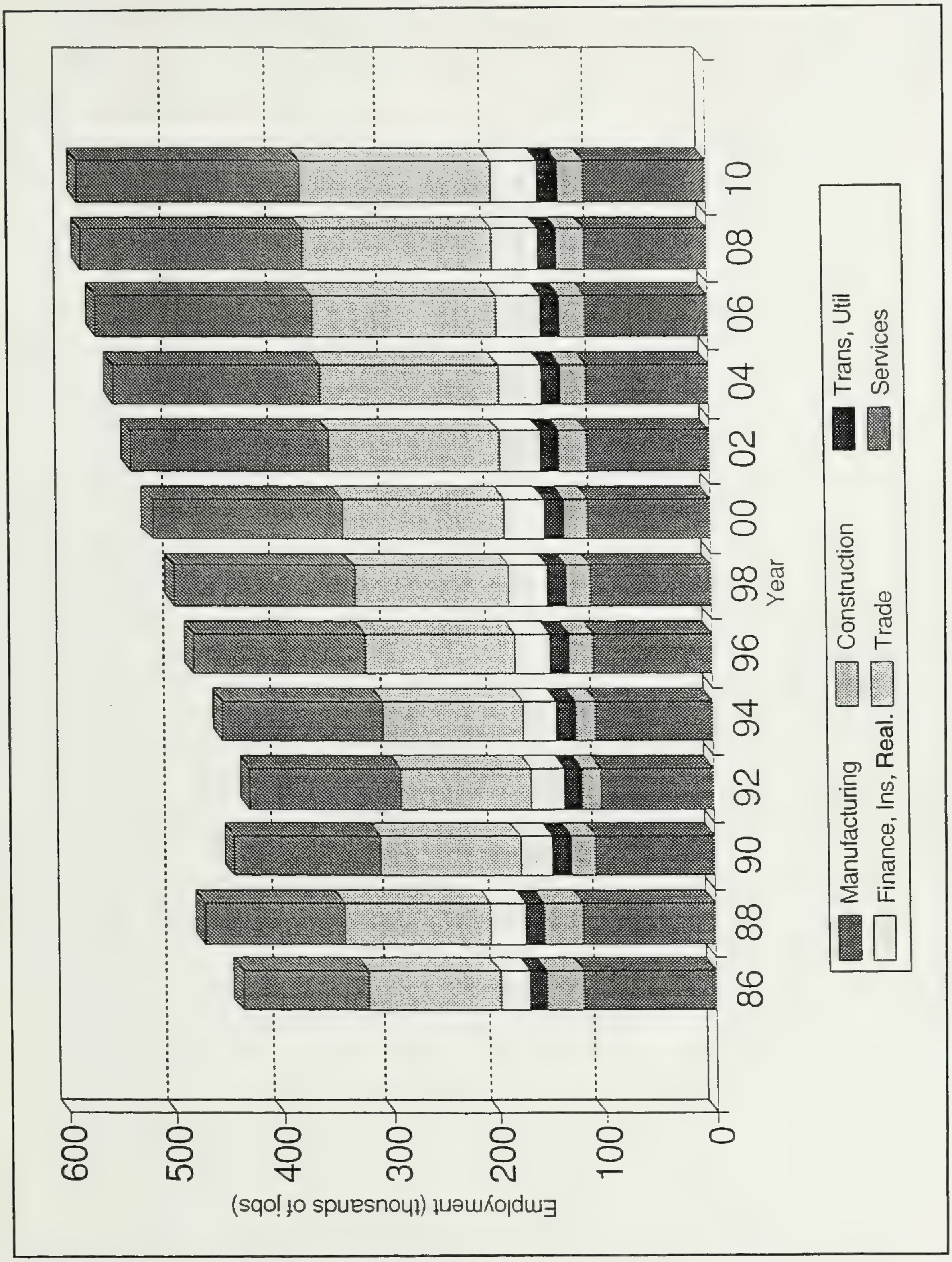
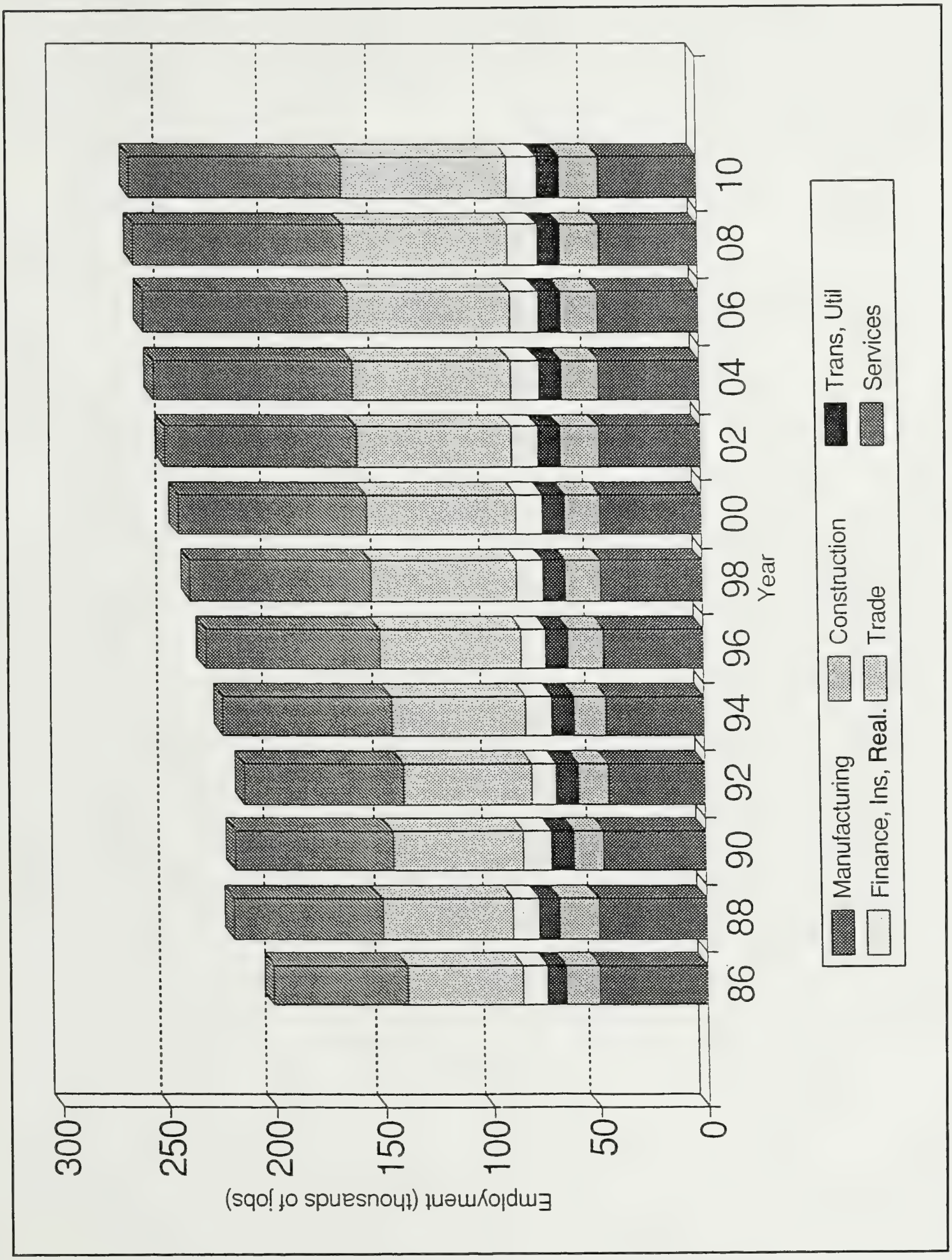


Figure 7.12 Vermont Employment Forecast, 1986-2010



8.0 Air Quality and Energy

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8.1 Air Quality

Criteria pollutants for which National Ambient Air Quality Standards have been defined under the Clean Air Act include Lead, Ozone, Nitrogen Oxides, Carbon Monoxide, Sulfur Dioxide, and Suspended Particulate Matter. Of these pollutants, the air quality focus of the New England Transportation Initiative is ozone. This is because ozone exceedances in New England are more severe than those of the other pollutants and also the regional nature of the ozone problem. Within the Northeast Corridor, the potential exists for precursor pollutants emitted as ozone formed within one urban area to move in a general northeasterly direction combining with the precursors emitted within other areas to create a problem that is worse than it otherwise would be in the absence of this transport phenomenon.

Within the New England states, isolated locations exist where monitored values for Carbon Monoxide and Suspended Particulate Matter (PM_{10}) are in violation of the standards but these are not considered regional problems. Carbon Monoxide emissions result primarily from transportation sources and have been declining roughly in proportion to the decreases in the motor vehicle emission standards.

There are no violations within New England of the standards for Lead, Sulfur Dioxide, or Nitrogen Oxides, although NO_X emissions are an important precursor of ozone and evidence exists that the formation of ozone within the Northeast Corridor may be influenced more by Nitrogen Oxide emissions than by Volatile Organic Compounds.

Ozone concentrations occur primarily during the summer and are affected by a large number of meteorological variables. In addition to maximum temperature, these include upper air temperature, dew point temperature, wind speed and direction, humidity, precipitation, and solar radiation or cloud cover. Consequently, peak ozone levels may vary significantly from year to year due more to natural fluctuations in the weather than to changes in the magnitude of precursor emissions. For example, unusually high levels of ozone were recorded throughout the northeast during the summers of 1983 and 1988. In particular, ozone levels unlike those of carbon monoxide have not decreased proportionally to lower emissions from motor vehicles.

This section summarizes historical ozone trends nationally and in each of the six New England states. Unlike the other factors being examined in this report, the emphasis is on historical rather than projected future trends. Under provisions of the 1990 Amendments to the Clean Air Act, states are required to demonstrate attainment of the National Ambient Air Quality Standards by a particular date that is a function of the degree to which the area was in nonattainment in 1990. For areas such as southwestern Connecticut that are

classified as being in severe nonattainment of the standard, the attainment date is 2007. For serious nonattainment areas, the attainment date is 1999, and for areas designated as being in moderate nonattainment of the ozone standard the date is 1996. The important question then is whether actual monitored ozone levels are decreasing at a rate that is sufficient to achieve these legislatively mandated demonstration dates of attainment.

Consistent with the requirements of the Clean Air Act, trends in ozone are presented in the form of two indicators of maximum values: the number of days on which the ozone standard is exceeded and the second highest one-hour concentration of ozone. Three important considerations need to be kept in mind when examining trends in these extreme indicators:

1. Maximum value indicators are particularly sensitive to meteorological fluctuations. According to the National Academy of Sciences, a measure such as the second highest daily one-hour concentration, "masks underlying trends and is therefore not a reliable indicator of an area's progress in reducing ozone over several years." It may be more desirable to examine changes in the mean value or in the distribution of ozone levels. Such data, however, are not as readily available.

2. The choice of time period over which a trend is examined is critical given the importance of meteorology. For example, the manner in which the extreme years of 1988 and 1983 are treated in a trends analysis very much influences the conclusions that will be reached. For example, a five-year trend from 1988 to 1993 is almost guaranteed to show a significant reduction in ozone levels since meteorological conditions in 1988 were much more conducive to ozone formation than they were in 1993.

3. The factors affecting the formation of ozone are highly nonlinear in their effect. These include temperature as well as the magnitude of NO_X and VOC precursor emissions. For example, the NAS reports that "ozone concentrations appear to show no dependence on temperature below 70-80^{o}F, but they become strongly dependent on temperature above 90^{o}F."

Nationally, there was a 38 percent decrease in the number of ozone exceedance days during the nine-year period, 1982-1991. During this same period, however, there was only an eight percent decrease in the second highest daily maximum one-hour ozone level. Examining changes in precursor emissions during this same period, VOC emissions decreased 13 percent and NO_X emissions decreased eight percent. Changes in aggregate national air quality statistics, though, do not necessarily reflect what is happening within a particular air quality nonattainment area. This is especially the case within New England where ozone generated within one area can be transported to other portions of the region.

Monitoring sites in four southern New England non-attainment areas track the number of day on which ozone standards are exceeded. Figure 8.1 shows the number of exceedances between 1980 and 1993, demonstrating a downward trend over this 13-year period. The number of 1993 exceedances, though, is higher than in 1992. Also, the trend is not consistently downward, with 1991 being a year in which the number of exceedances was higher than in either of the two preceding years.

Ozone levels for greater Connecticut are shown in Figure 8.2, displaying the trends in the first, second, third, and fourth maximum hours for the period 1980-1993. While an increase occurred in 1993 levels, there still is an overall downward trend over these 13 years. As reported in work performed by Sigma Research for the Lake Michigan Ozone Study, Rao reported in 1992 that, "there is a significant downward trend in the Connecticut (air quality) data but not in the New Jersey or New York City data." An analysis conducted by the Connecticut Department of Environmental Protection of ozone monitoring data collected between 1976 and 1987 at ten Connecticut locations showed that, "exceedances of the ozone standard have been reduced for those days when interstate transport of precursors from the southwest is insignificant."

Two ozone monitors in Rhode Island are located in the City of Providence and on the Alton Jones Campus in West Greenwich. Data representing an average of the two monitors are plotted in Figures 8.1 and 8.3. These show no violations of the ozone standard in 1993. In contrast to the Connecticut data, 1993 ozone levels in Rhode Island improved rather than worsened. Other than this, the Rhode Island trend is similar to that in Connecticut. Peaks occurred in 1983 and 1988, and 1991 levels were higher than data recorded in either 1989 or 1990.

In work being performed for the U.S. Federal Highway Administration and the Volpe National Transportation Systems Center, Cambridge Systematics has examined trends in monitored Massachusetts air quality data. Data for the Boston-Lawrence-Worcester area in eastern Massachusetts and for the Springfield area in the western portion of the state are displayed in Figure 8.4 and 8.5, respectively. In both cases, the curves are visually flatter than the corresponding data for Connecticut and Rhode Island. Where the analysis methodology utilized by the U.S. Environmental Protection Agency in its "national trends" report resulted in an ozone level that was classified as "stable" between 1982 and 1991, statistical analyses conducted by Cambridge Systematics, both considering meteorology and independent of meteorology, showed a statistically significant downward trend.

Temporal patterns of Massachusetts ozone levels were analyzed by the Massachusetts Department of Environmental Protection in 1989 for the seven-year period, 1980-1986. The most significant finding from this work was that, "on most days when Massachusetts monitors recorded ozone concentrations in excess of the national standard, the general wind direction across the state was southwest." Monitored ozone concentrations on high transport days were in the range of 55-60 percent higher than on low transport days. Examining average daily maximum ozone levels, no downward trend in ozone concentration was apparent. This was especially the case when examining individual monitors where the data showed, "considerable variation." Analyses of the highest and second highest ozone values, however, did show a decreasing trend over this seven-year period.

Vermont ozone trends are shown in Figures 8.6 and 8.7 for three monitoring stations: Burlington, Bennington, and Underhill. Vermont is in attainment of the ozone standard, but is part of the Northeast Ozone Transport Region. Figure 8.6 plots second highest one-hour daily maximum values, while Figure 8.7 displays seasonal averages of one-hour ozone recordings. The long-term trend for the University of Vermont site in Burlington, which was discontinued after 1988 when the Underhill monitor came online, shows no

significant downward trend. The highest ozone readings in Vermont are recorded at the Bennington monitor. After the 1988 peak, values were lower in 1989 and 1990, although 1990 levels were higher than 1989.

The number of days for which the maximum ozone level exceeded the national standard is shown in Figure 8.8 for three New Hampshire monitoring sites for the five-year period, 1988-1992. The highest levels are recorded at the Rye Harbor monitor located on the coast. After the summer of 1988, ozone levels have held relatively stable with values holding near or somewhat below the standard with the exception of 1991 where a larger number of exceedances were recorded.

Ozone trend data for the State of Maine are plotted in Figure 8.9 relative to the state ozone standard of 0.08 ppm. When expressed in terms of the federal ozone standard of 0.12 ppm, violations still occur although the number is considerably lower. In 1991, violations of the federal standard occurred at seven of Maine's 11 ozone monitoring stations. The largest number of violations occurred at the Cape Elizabeth (4), Kennebunk (4), Port Clyde (4), and Isle Au Haut (5) monitors. Similar to the patterns for Vermont and New Hampshire, the number of violation hours per year in Maine does not show a significant downward trend. Like the other New England states, 1988 represents a peak condition. The other years show a pattern of both increases and decreases. For 1991, the maximum number of violations of the federal standard was five, with four violations of the federal standard being recorded at three other monitors. As in the other New England states, Maine estimates that the majority of the state's ozone pollution is transported into the state from sources located outside the state.

The following qualitative conclusions can be drawn from the ozone trend data presented for the six New England states:

1. There is considerable year-to-year variation in monitored ozone levels in each of the six states, with the data showing year-to-year increases as well as decreases.

2. The historical pattern of ozone levels in the three northern states is much more stable than in the three southern states where a decreasing trend is discernible.

3. In none of the New England states is the change in monitored ozone levels nearly proportional to the decrease which has occurred in motor vehicle emissions over the same period.

4. The trend in ozone levels is not sufficient by itself to result in attainment of the National Ambient Air Quality Standards within the time frame required by the Clean Air Act.

These findings are consistent with an analysis of New England ozone levels conducted by the Region I office of the U.S. Environmental Protection Agency for the 1981-1991 time period. Data from 14 monitors were combined into a single dataset and statistically analyzed. Nine of the 14 monitoring sites were located in either Connecticut or Massachusetts, with the other five coming from Rhode Island, Maine, and New Hampshire. Four separate ozone indicators were examined, representing both maximum and average conditions. Overall, there was a downward trend in each of the four indicators examined.

The significance of the downward trend became greater when the 11 summer periods being analyzed were classified based on a measure of "similar summers." The three years of 1983, 1988, and 1991 were defined as "hot" summers, and the five years of 1981, 1982, 1984, 1989, and 1990 were classified as "cool" summers. Grouping the data in this manner in order to account for differences in meteorological conditions resulted in downward trends of higher statistical significance.

While individual vehicle emission rates are decreasing, total vehicle miles of travel are increasing. It is important to also examine the trend in aggregate on-road vehicular emissions. While mobile source emissions are decreasing, the effects of VMT growth may at some future point in time more than offset the effects of both an increasingly cleaner vehicle fleet and control strategies such as reformulated fuel and enhanced vehicle inspections/maintenance.

New Tier I vehicle emission rates incorporated in the Clean Air Act Amendments of 1990 became effective with the 1994 model year. The Clean Air Act also gives the EPA Administrator the option of adopting even lower Tier II vehicle emission standards. Such standards, though, could not be effective before "model years commencing after January 1, 2003." Under provisions of the Clean Air Act, Massachusetts and New York currently are scheduled to start the phase-in of California LEV standards in 1995. Phase-in of the alternative voluntary vehicle emission standards being proposed by the American Automobile Manufacturers Association (AAMA) would be accomplished over a three-year period starting during model year 2001 when 30 percent of new vehicles manufactured by participating companies would meet the new standard.

In analyses conducted for the Federal Highway Administration by Cambridge Systematics using statewide data for Massachusetts and assuming only the current Tier I vehicle emission standards, the curve for vehicular VOC emissions flattens out after the year 2000 and turns slightly upward after 2010 (Figure 8.10). The curve for NO_x emissions, though, is significantly different. These emissions are projected to bottom out shortly after the year 2000, but are then projected to increase at a much higher percentage rate than for VOC emissions (Figure 8.11).

Assuming full implementation within the fleet of light duty vehicles, the California LEV standards result in a non-methane hydrocarbon (NMHC) vehicle emission rate that is 31 percent lower than that proposed by the AAMA, 0.09 versus 0.13 grams/mile. The NO_x emission rate for the California LEV vehicle fleet is projected to be 15 percent lower than under the AAMA proposal. Examining total emissions for the Ozone Transport Commission (OTC) region, VOC emission benefits for the California LEV program compared to the AAMA proposal are 21 tons per day in the year 2000, peaking at 105 tons per day in the period 2005 to 2007. Corresponding NO_x emission benefits for the OTC region are 38 tons per day in 2000, increasing to 240 tons per day in the 2005-2007 period.

8.2 Energy

An examination of trends in motor vehicle energy consumption yields a similar finding to the results of the air quality trends analysis. The growth in energy consumption resulting from the increase in total travel is more than offsetting the effects of technology improvements in improving the fuel economy of individual vehicles. Despite the existence of the Corporate Average Fuel Economy (CAFE) standards and other energy conservation initiatives, transportation energy consumption has been on an upward trend over the last 30 years. The trend in motor gasoline consumption in each of the six New England states, expressed in terms of thousands of barrels of petroleum consumed per year, is shown in Figure 8.12. Massachusetts has the largest aggregate consumption, nearly double that of Connecticut and over five times that of Maine, Rhode Island, New Hampshire, and Vermont. Despite decreases in the 1974 and 1979 "energy crises," the upward trend in motor vehicle fuel consumption in each state is evident from Figure 8.12. The 1990 decreases result from price increases associated with the Persian Gulf war. The continued decrease in 1991 is consistent with national patterns that saw small decreases in both transportation and industrial energy consumption as a result of broader economic conditions regionally and nationally.

Examining changes in energy consumption over the 11-year period, 1981-1991, there was an overall 10 percent increase across the country. There is, however, considerable state to state variation with seven states within the country showing decreases. Within New England, New Hampshire and Maine both showed increases of approximately 30 percent, well above the national average.

Nationally, transportation accounts for approximately 25 percent of total energy consumption, and has held constant at this figure over the past 30 years. There is, however, considerable state-to-state variation with transportation representing 40 percent of total energy consumption in Rhode Island, 43 percent in Vermont, and 35 percent in Maine. During this period, total national transportation energy consumption has increased from 11 quadrillion BTUs to 22 quadrillion BTUs.

It also is useful to examine the pattern of energy consumption within the transportation sector:

- Petroleum accounts for over 95 percent of the fuel consumed by all transportation sources.

- Transportation has increased over the past 20 years as a contributor to the oil dependency of this nation. In 1973, total transportation petroleum consumption represented just over 90 percent of total U.S. crude oil production. By 1990, this had increased to 140 percent, meaning that transportation now consumes more petroleum than is produced within this country.

- Highway transportation represented 77 percent of total transportation energy consumption in 1990.

- Within the highway sector, the majority of fuel is consumed by automobiles but fuel consumption by trucks has been increasing as a percentage of total highway energy consumption while automobile energy consumption on a percentage basis has been decreasing. Between 1970 and 1990, the percentage of highway fuel consumed by light trucks increased from 10 to 19 percent, and fuel consumed by medium and large trucks increased from 10 to 16 percent of total highway energy use. During this same period, automobile energy use decreased as a percentage of total highway energy usage from 56 to 42 percent.

- Energy consumed by air, rail, water, and pipeline transportation accounted for 23 percent of total national transportation energy consumption in 1990. Within these modes, 10 percent of transportation energy was consumed within the air sector by domestic air carriers, international air carriers, and general aviation. Water transportation accounted for seven percent of transportation energy consumed on a national basis, and pipeline and rail represented four and two percent respectively.

The U.S. Department of Energy prepares an "annual energy outlook." Projections by fuel type and demand sector are developed for the year 2010 using the Energy Information Administration's National Energy Modeling System (NEMS). The following are highlights for the transportation sector from the 1994 report:

- Transportation's share of total energy consumption is projected to grow between 1990 and 2010, increasing to 37 percent by 2010.

- Fuel efficiency is projected to improve for all transportation modes between 1990 and 2010. The largest increase, 18 percent, occurs for freight trucks. Light duty vehicle fuel efficiency is estimated to improve by 14 percent.

- Light duty fuel consumption is projected to increase by one percent annually between 1990 and 2010. A 1.6 percent annual increase in VMT is offset by the 0.6 percent per year improvement in vehicle fuel economy.

- By the year 2010, transportation will account for approximately one-half of carbon emissions from within the energy sector, 500 out of 1,000 million metric tons per year. Hydrocarbon fuels, on average, contain at least 75 percent carbon by weight. For every ton of fossil fuel consumed, three-quarters of a ton of carbon enters the atmosphere.

The introduction of alternatively fueled vehicles is identified by the Department of Energy as the major challenge for the future within the transportation sector. While alternatively fueled vehicles are projected to account for only 2.3 percent of light duty vehicle sales in 1995, this share is estimated to increase to 10.6 percent by 2005 and 11.4 percent by 2010. Factors influencing the rate at which alternatively fueled vehicles enter the market and the type of vehicles that are sold include the Energy Policy Act of 1992, the degree to which the California LEV vehicle emission standards are implemented by other states, and acceptance of these vehicles by the consumer market. Acknowledging these uncertainties, the following shares by technology type are estimated by DOE to occur within the alternative fuel light duty vehicle fleet by the year 2010:

Technology	Market Share (Percent)
Compressed Natural Gas	26.4%
Liquefied Petroleum Gas	19.4%
Electric Hybrid	17.8%
Methanol-Flex	13.0%
Dedicated Electric	12.2%
Other	11.2%

State level projections of future energy consumption have been developed within the New England states by Massachusetts and Vermont using the SAFER Energy model in conjunction with the REMI economic forecasting model. A similar six-state regional estimate currently is being developed by the New England Governors' Conference.

As part of the 1993 Massachusetts State Energy Plan, baseline transportation energy consumption, considering all transportation modes, was forecast by the Massachusetts Division of Energy resources to increase from 402 trillion BTUs in 1990 to 593 trillion BTUs in 2010. (This baseline assumes implementation of the California LEV standards, including the introduction of ZEVs or electric vehicles.) This baseline forecast represents an increase of 48 percent, or a compound annual growth rate of 1.9 percent. The transportation sector proved to be more resistant to additional policy intervention beyond the California LEV and clean fueled vehicle fleet requirements already incorporated in the assumed baseline than residential, commercial, or industrial energy consumption. Including the effects of electric vehicle and other alternative fuel initiatives beyond what already was included in the baseline, it was estimated that year 2010 transportation energy consumption would be reduced by approximately 1.7 percent, from 593 to 583 trillion BTUs.

Vermont developed a comprehensive state energy plan in response to the Governor's executive Order No. 79. The goal of the plan was to achieve a 20 percent reduction in per capita non-renewable energy use by the year 2000. The transportation sector accounted for 45 percent of total statewide energy consumption in 1990, considering all fuels. Between 1990 and 2010, transportation energy usage was projected to increase by 54 percent, more than any other sector and roughly half of the total 45 TBTU increase projected to occur in base conditions over this twenty year period.

The Vermont energy plan contains 13 separate transportation policies, structured into four general strategies. Examples include:

- A program of sales tax surcharges and rebates on the sale or lease of automobiles and light trucks;

- An increase in the fuel economy standards to 45 mph for passenger cars and 35 mpg for light trucks;

- An increase in gasoline and diesel fuel taxes;
- An alternative fuels and technology program;
- An increased emphasis on public transportation, including rail, bus, vanpool and rideshare programs;
- More energy efficient local and regional development patterns; and
- Increased use of telecommuting and telecommunications.

Considered individually, many of these policies had measurable but relatively small impacts, on the order of a 1 percent decrease in year 2000 energy consumption. Some policies, however, were projected to have considerably larger impacts. The vehicle "feebate" policy was projected to decrease energy demand in the residential transportation sector by 14.2 percent by the year 2000. The increased fuel economy standards would result in a 6.3 percent decrease in year 2000 base case energy usage. The effect of changed land use patterns was a 12.6 percent reduction in residential transportation energy demand relative to the year 2000 base case.

Examining the aggregate impact of all policies contained in the Vermont energy plan, the growth in transportation energy demand between 1990 and 2010 was projected to decrease from 25.19 TBTU to 6.07 TBTU. Transportation energy demand is projected to decrease between 1990 and 2000, from 43.19 to 42.65 TBTU, but then increases to 49.26 TBTU by the year 2010. In the absence of the plan, transportation energy demand was projected to be 68.72 TBTUs. Vermont also reports that the, "improvements in energy efficiency do not come at the expense of the economy." Total personal income is slightly higher when the plan's energy policies are considered than under base case assumptions. In addition, statewide employment in the year 2010 is projected to be higher with the energy plan than without the plan's policies.

While the SAFER/REMI energy model is currently being implemented in Rhode Island as part of the New England Governors' Conference New England Energy Strategy Initiative, a draft state energy plan was prepared in 1993. This Rhode Island plan recommends a five-fold strategy to address transportation-related energy consumption in the state. Increase system efficiency through improved transportation system management; reduce the amount of vehicle miles of travel (VMT) by single occupancy vehicles through transportation demand management measures; increase vehicle efficiency of both autos and light duty trucks; reduce emissions through emission controls; and demonstrate and evaluated improved and alternative fuels.

Examining both historic and projected future trends in energy consumption, five overall findings are important:

1. The reliance on petroleum as the dominant fuel within the transportation sector is contributing to this nation's dependency on imported sources of oil.

2. Within the transportation sector, highway-related modes represent by far the largest source of energy consumption – eight times larger than the next largest mode.

3. The transportation sector is growing as a percentage of total energy consumption. Within the highway mode, fuel consumed by trucks is increasing at a proportionally faster rate than fuel consumed by automobiles.

4. The Corporate Average Fuel Economy (CAFE) standards are having an important effect in improving vehicle fleet fuel economy and reducing the relative contribution of automobile fuel consumption as a percentage of total fuel consumption. The CAFE standards, however, are not sufficient by themselves to offset the increased fuel consumption that is associated with an overall growth in vehicle miles of travel.

5. Alternative sources of fuel will become increasingly important over the next 20 years as a result of provisions incorporated in the Clean Air Act Amendments of 1990 and the National Energy Policy Act of 1992. While petroleum will continue to be the dominant fuel, electricity, natural gas, and other fuels all could increase as a percentage of the energy market. At a minimum, transportation services provided within the New England region will have to take the introduction of these alternative fuels into account. From a policy perspective, the opportunity exists to take a proactive role in supporting and encouraging the implementation of alternative fuel sources.

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Figures

Figure 8.1 Ozone Violation Days, Southern New England

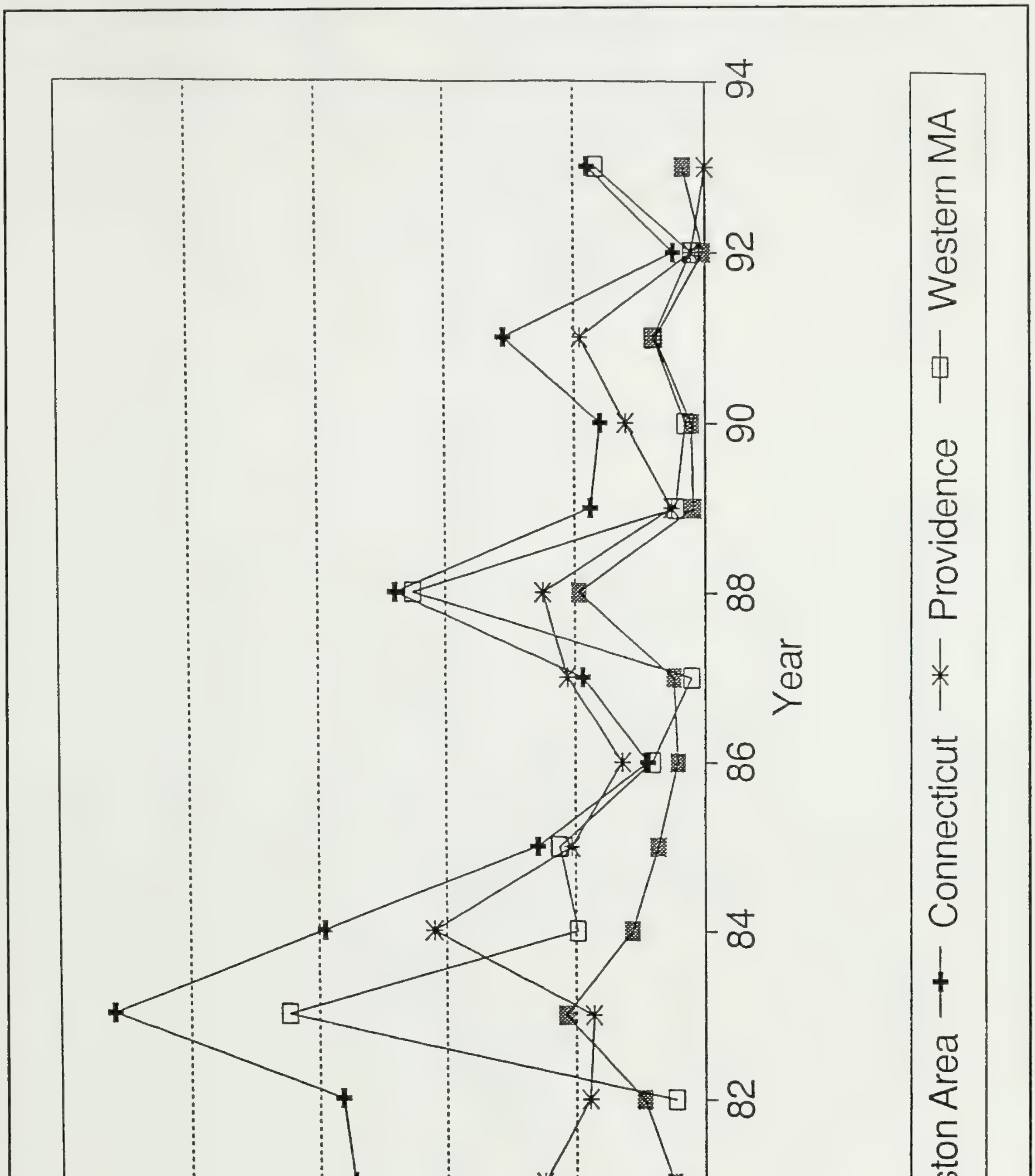


Figure 8.2 Ozone Levels, Greater Connecticut

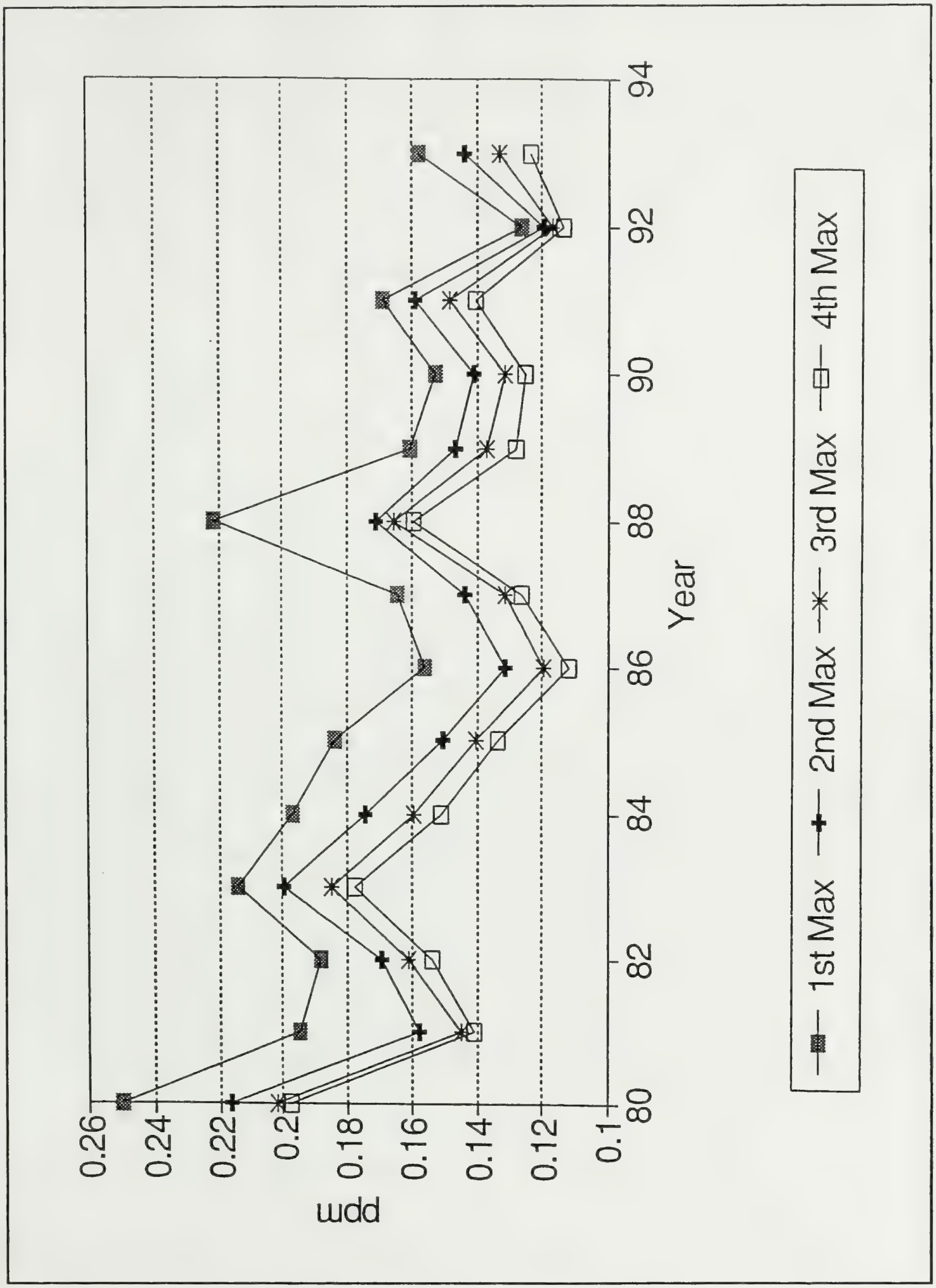


Figure 8.3 Ozone Levels, Providence (All Rhode Island)

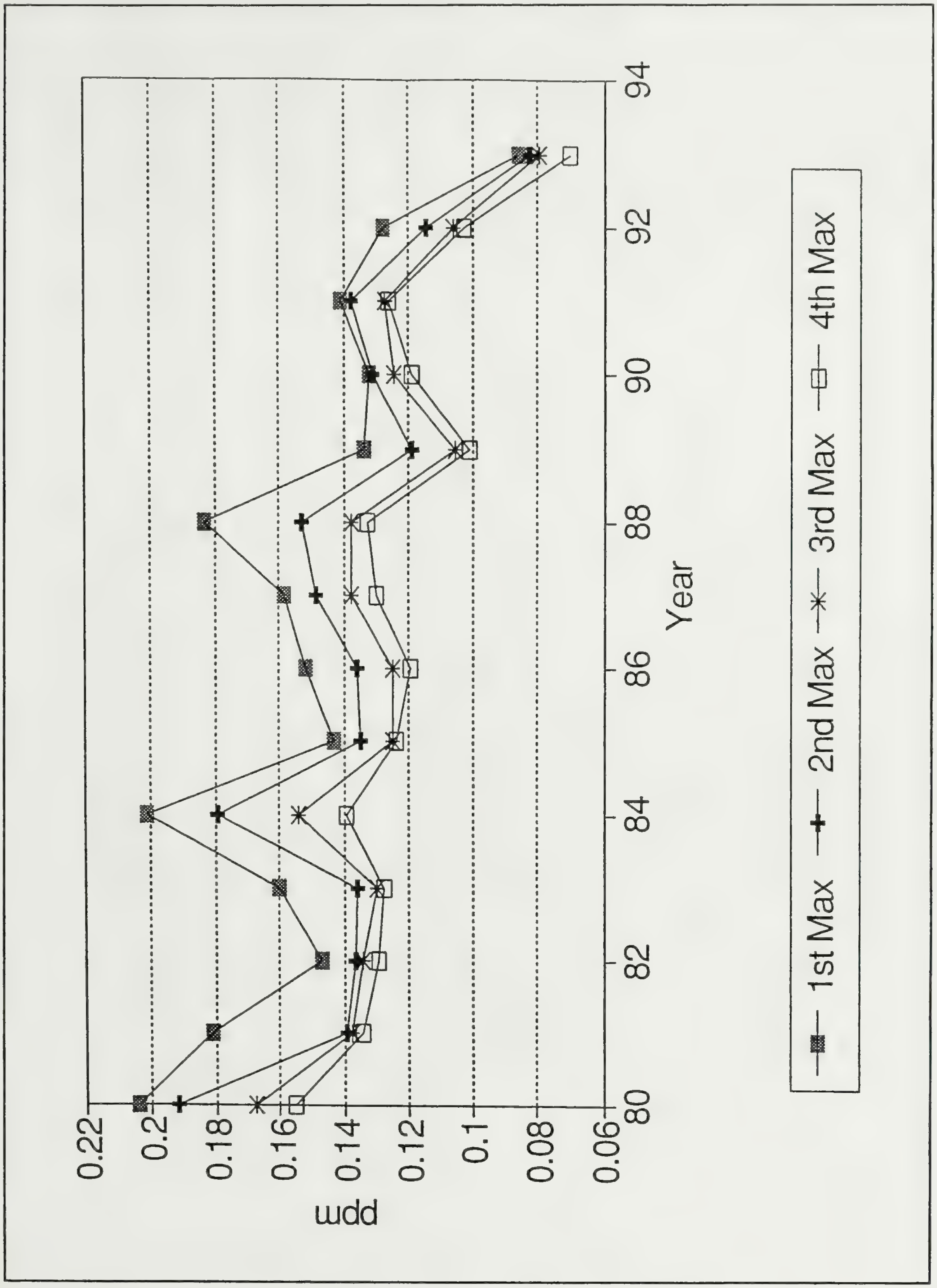


Figure 8.4 Ozone Levels, Boston-Lawrence-Worcester

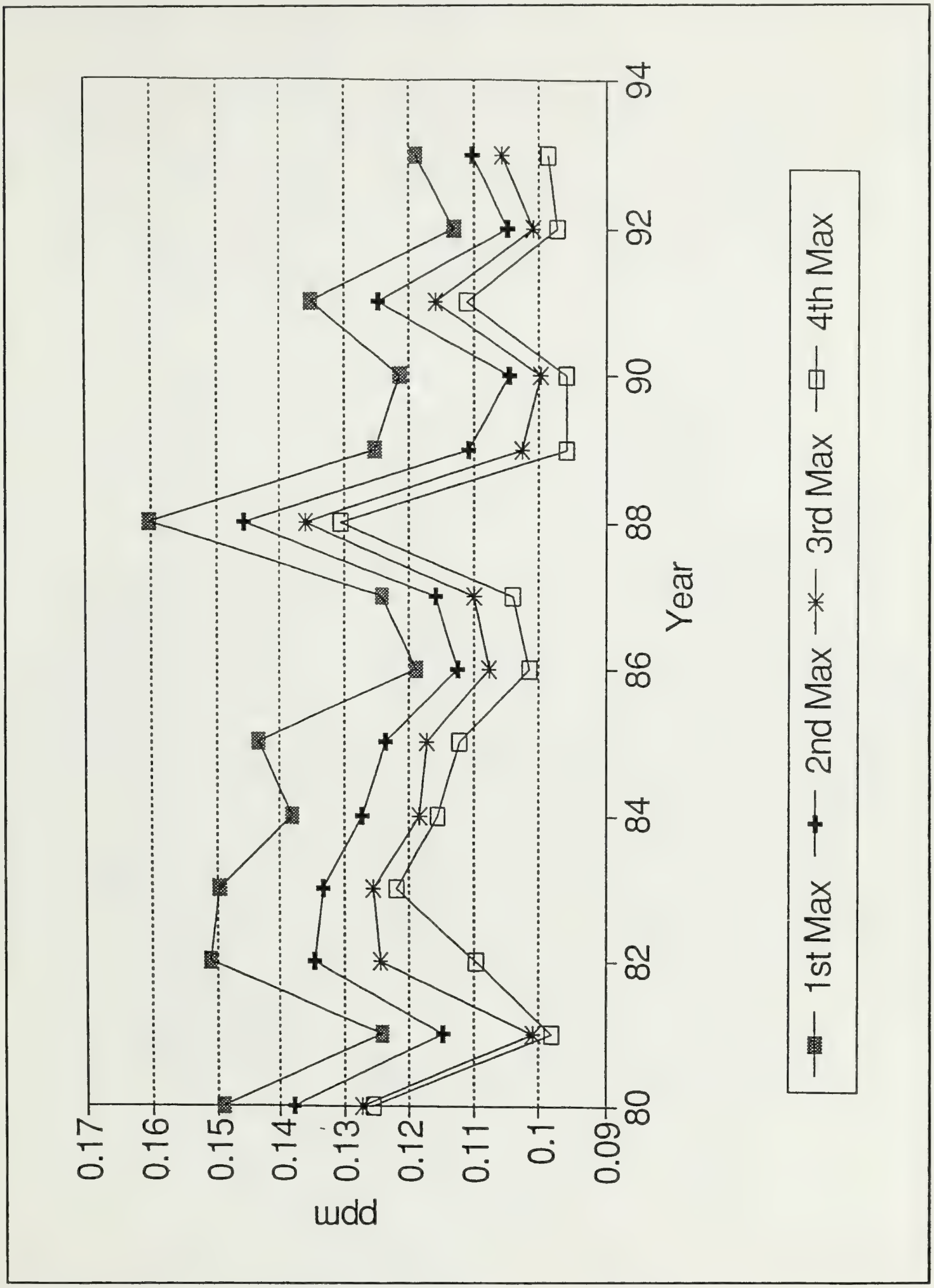


Figure 8.5 Ozone Levels, Springfield (Western Massachusetts)

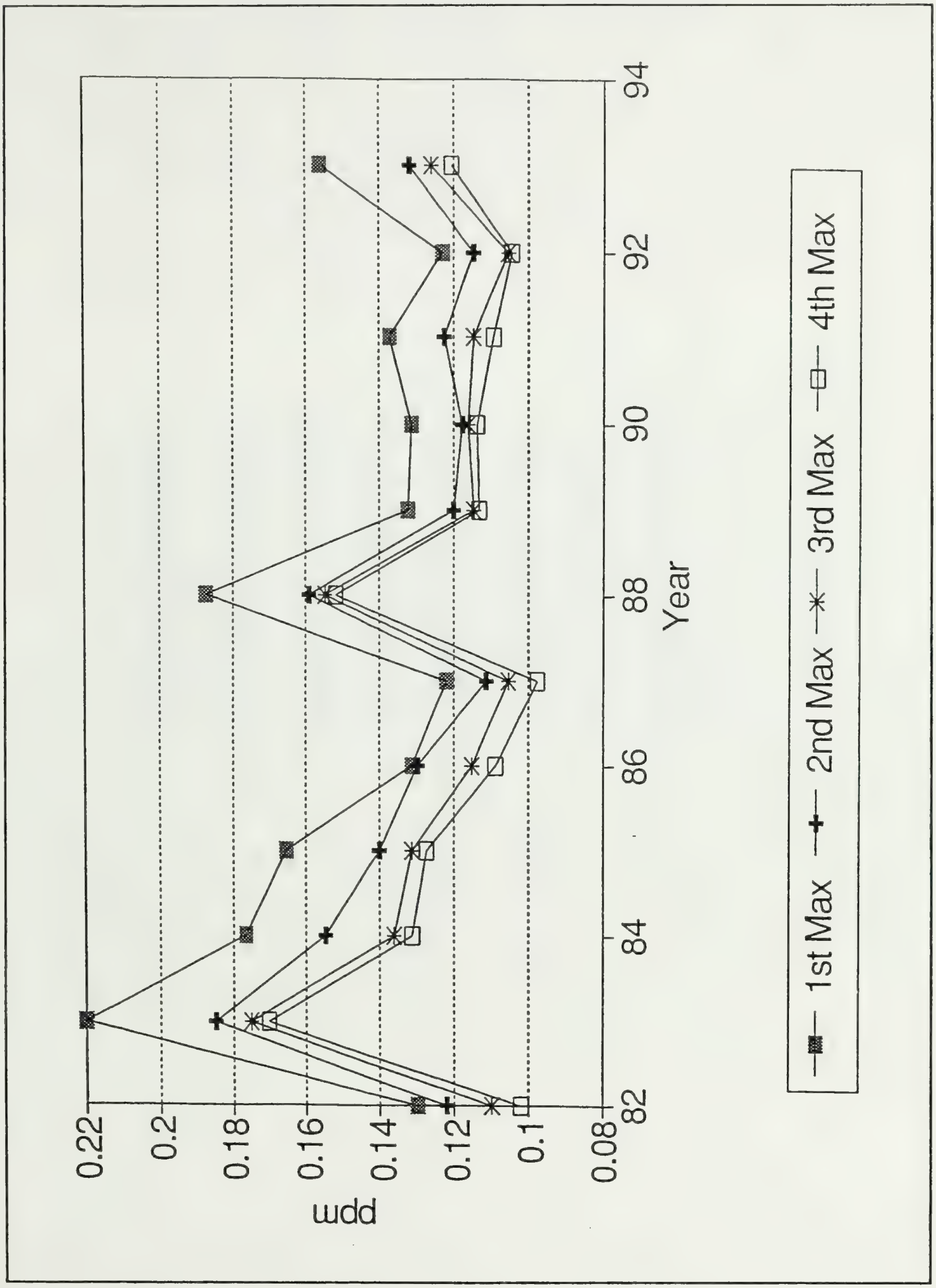
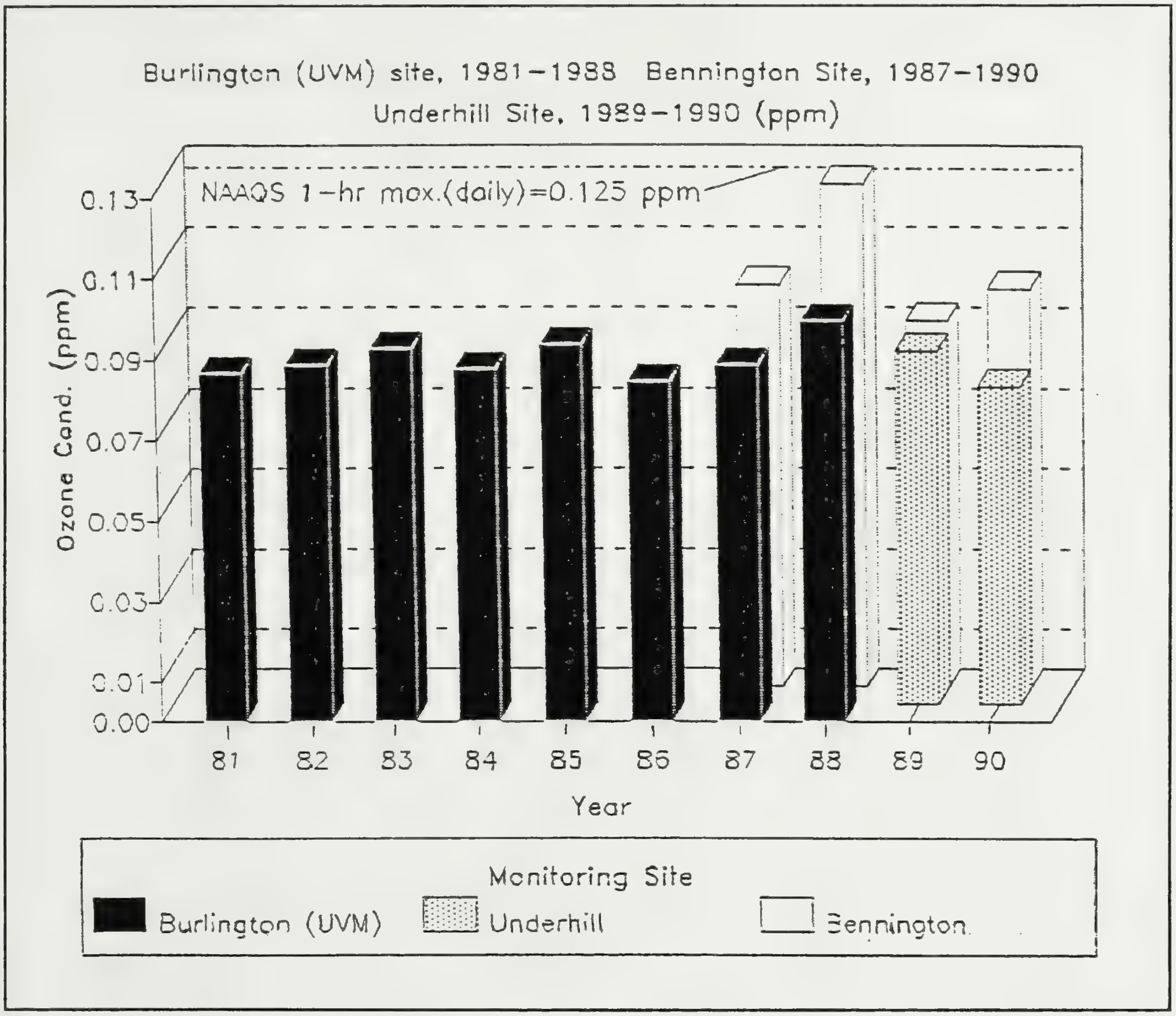
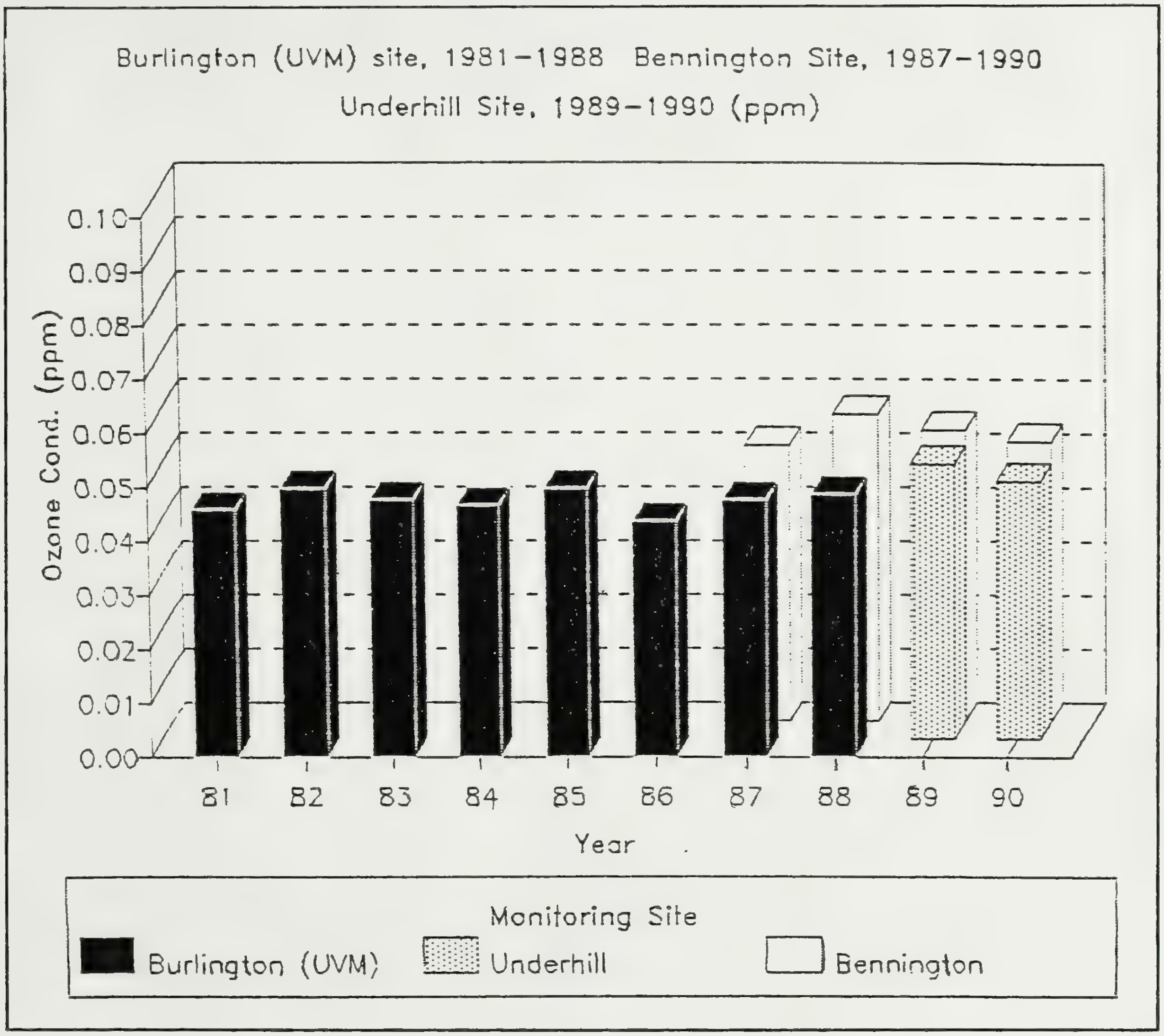


Figure 8.6 Vermont One-Hour Average Ozone Trend
(Second High, Daily Maximum)



* Ozone monitoring data from April to October.

Figure 8.7 Vermont Seasonal* Average Ozone Trend
(Second High, Daily Maximum)



* Ozone monitoring data from April to October.

Figure 8.8 New Hampshire Ozone

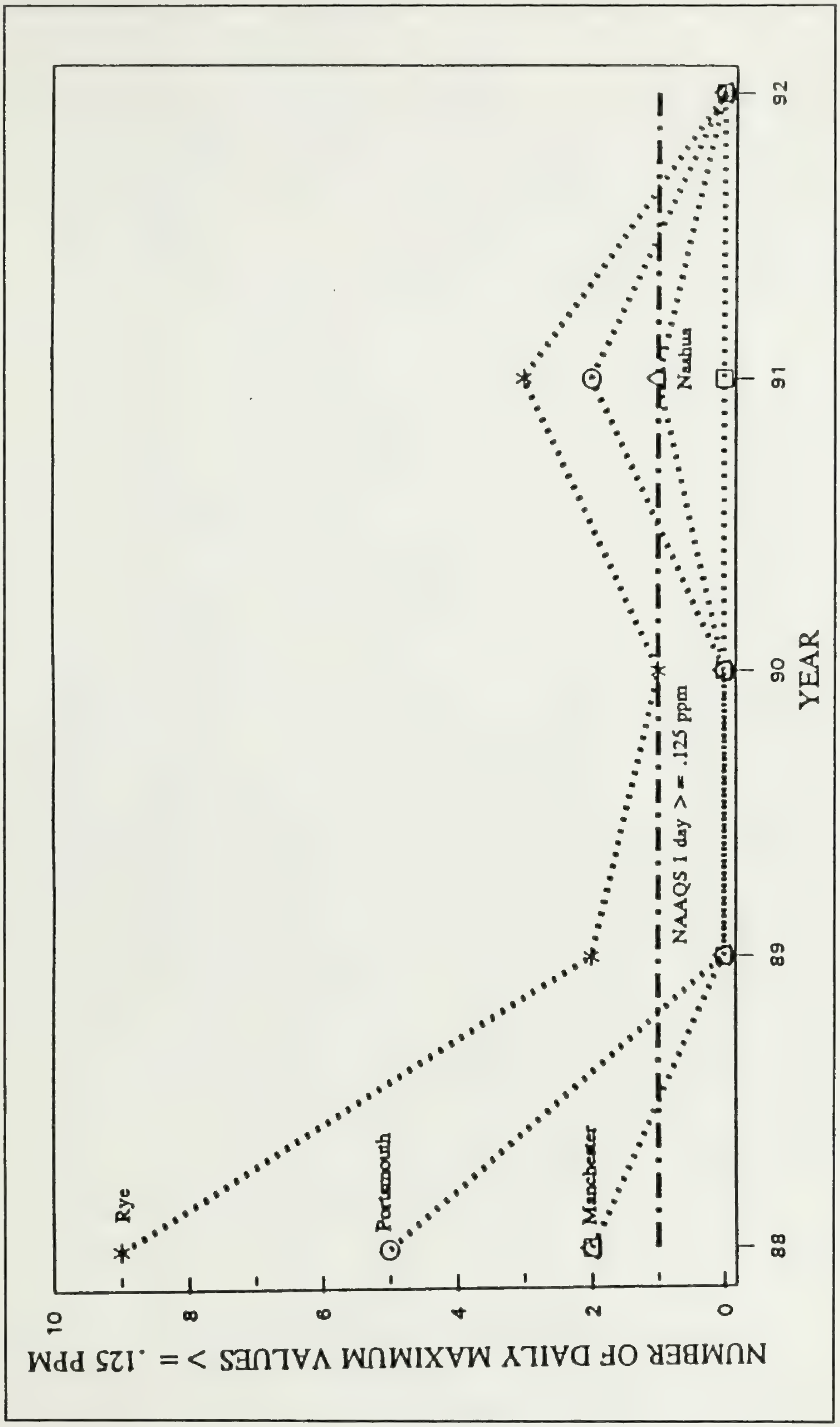


Figure 8.9 Maine Ozone Trends, Hours of State Violation

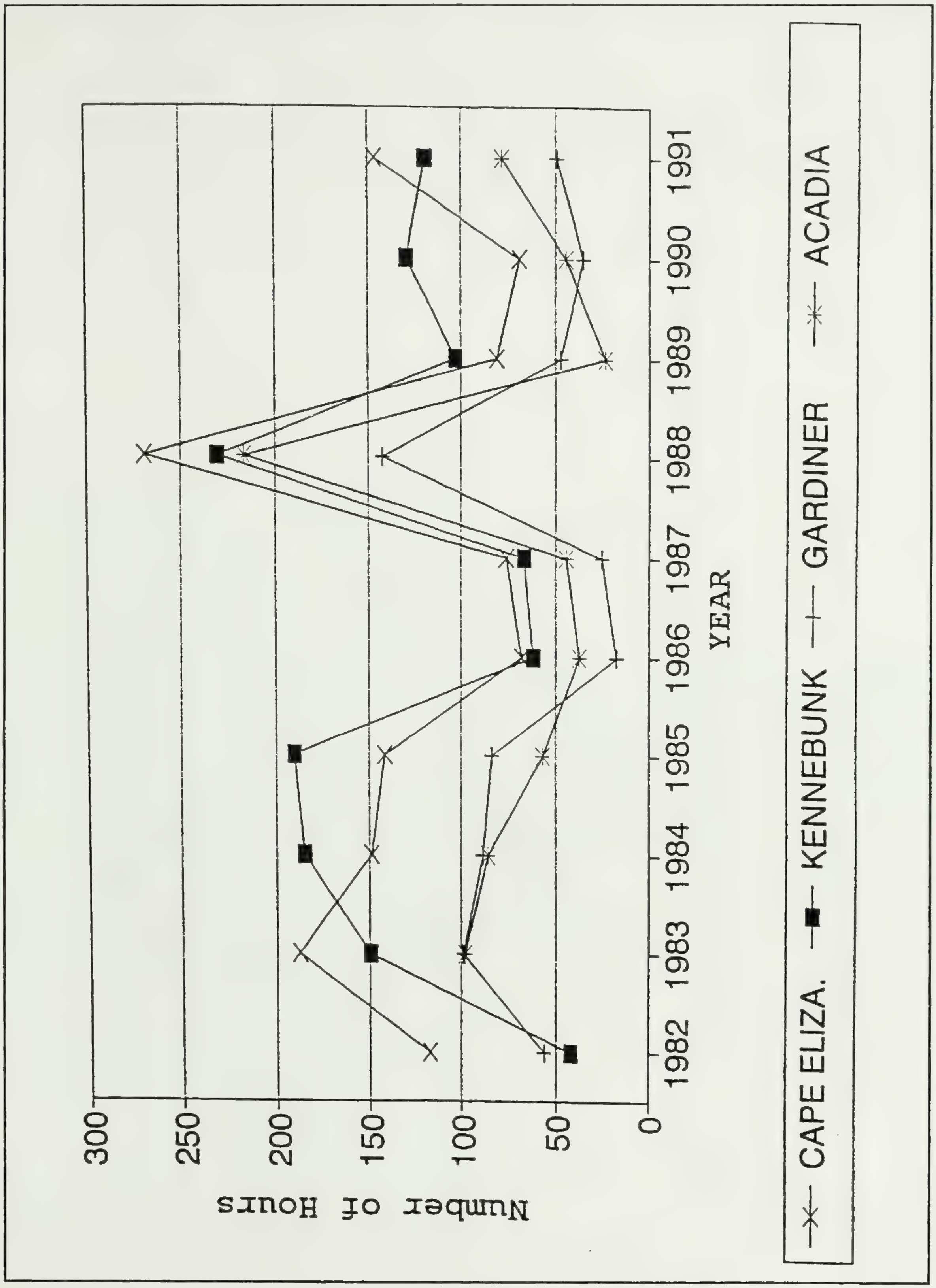


Figure 8.10 Massachusetts Air Quality Data, 1970-2030 VOC Emission Trends

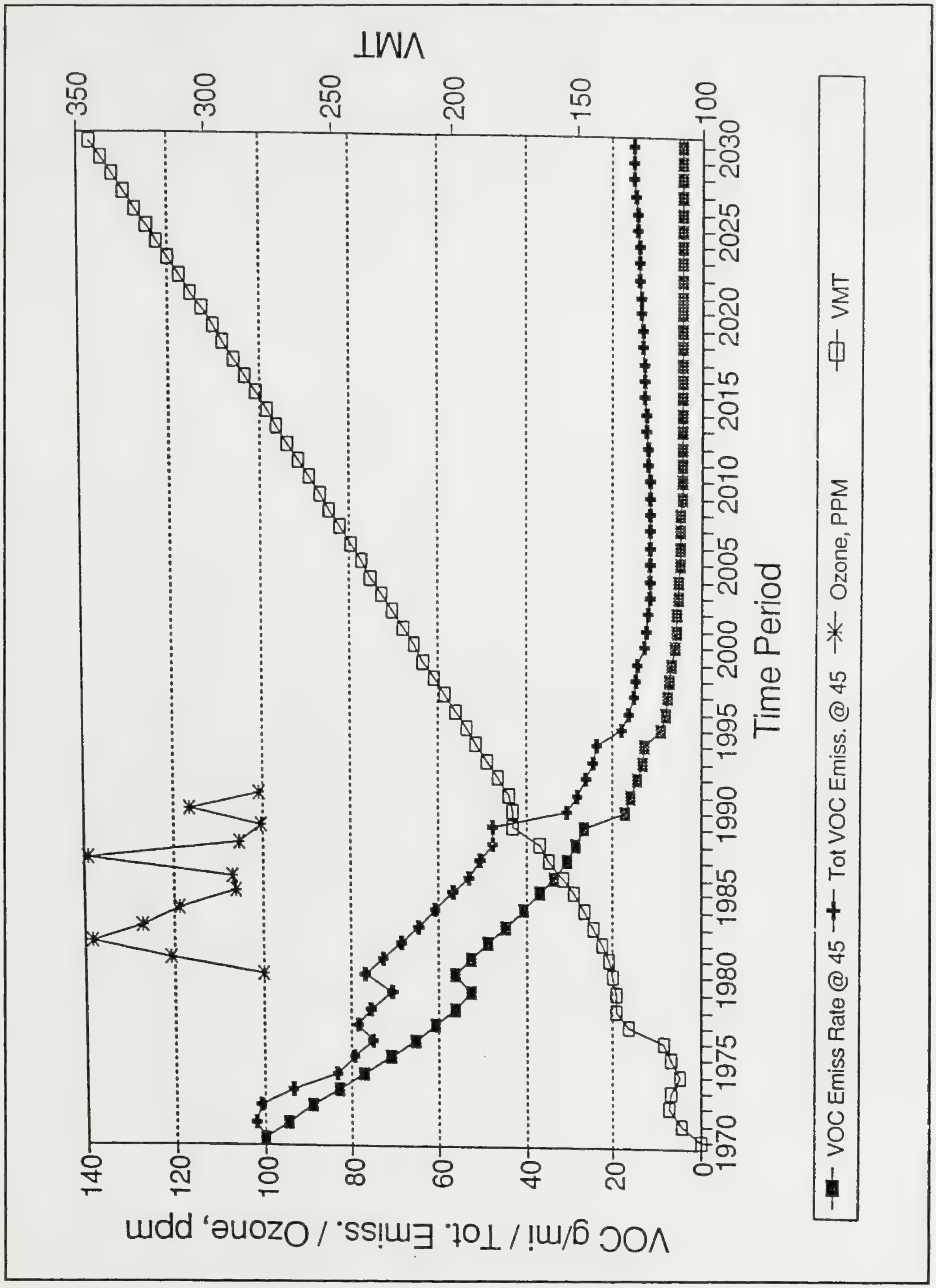


Figure 8.11 Massachusetts Air Quality Data, 1970-2030 NOX Emission Trends

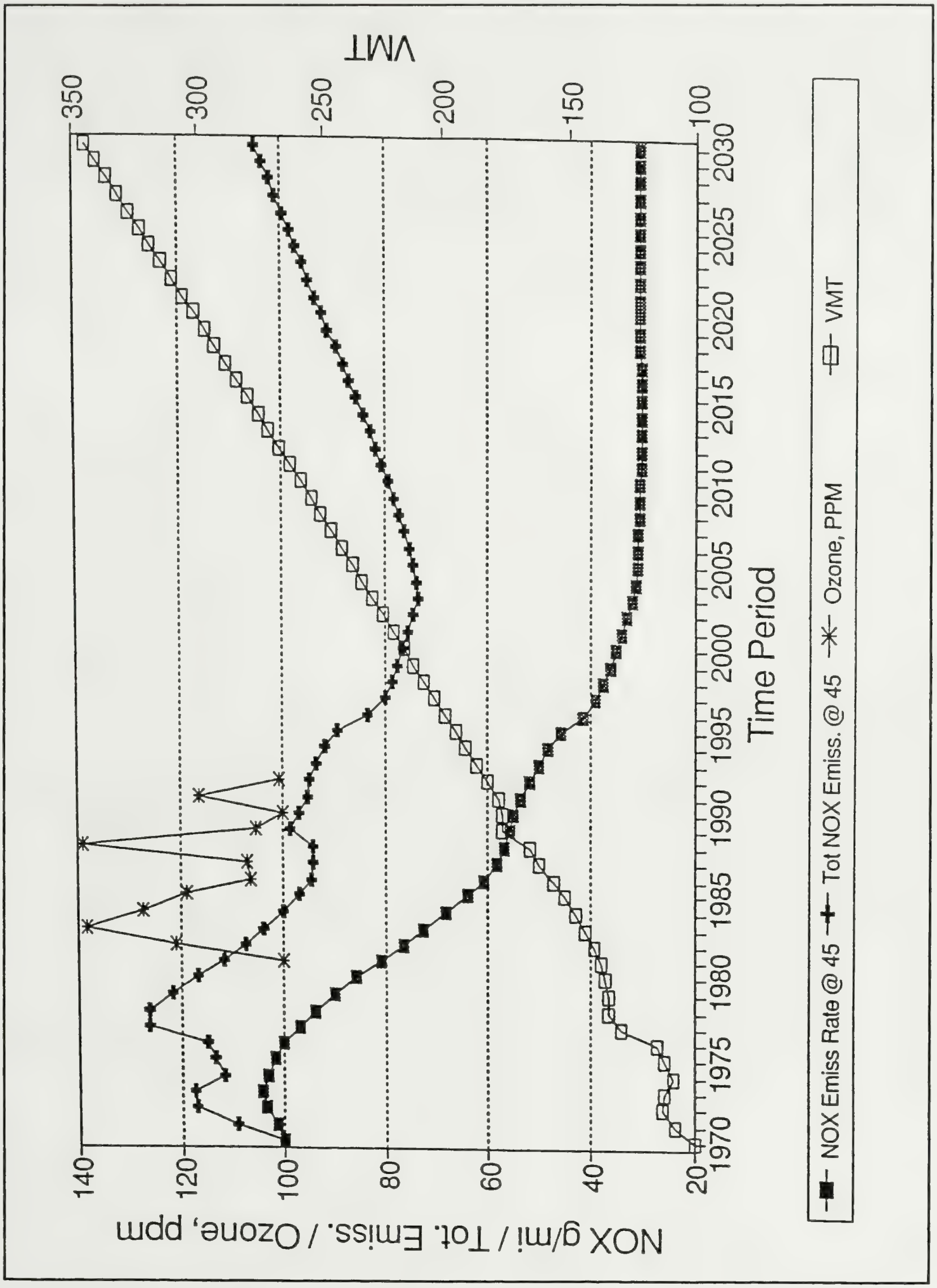
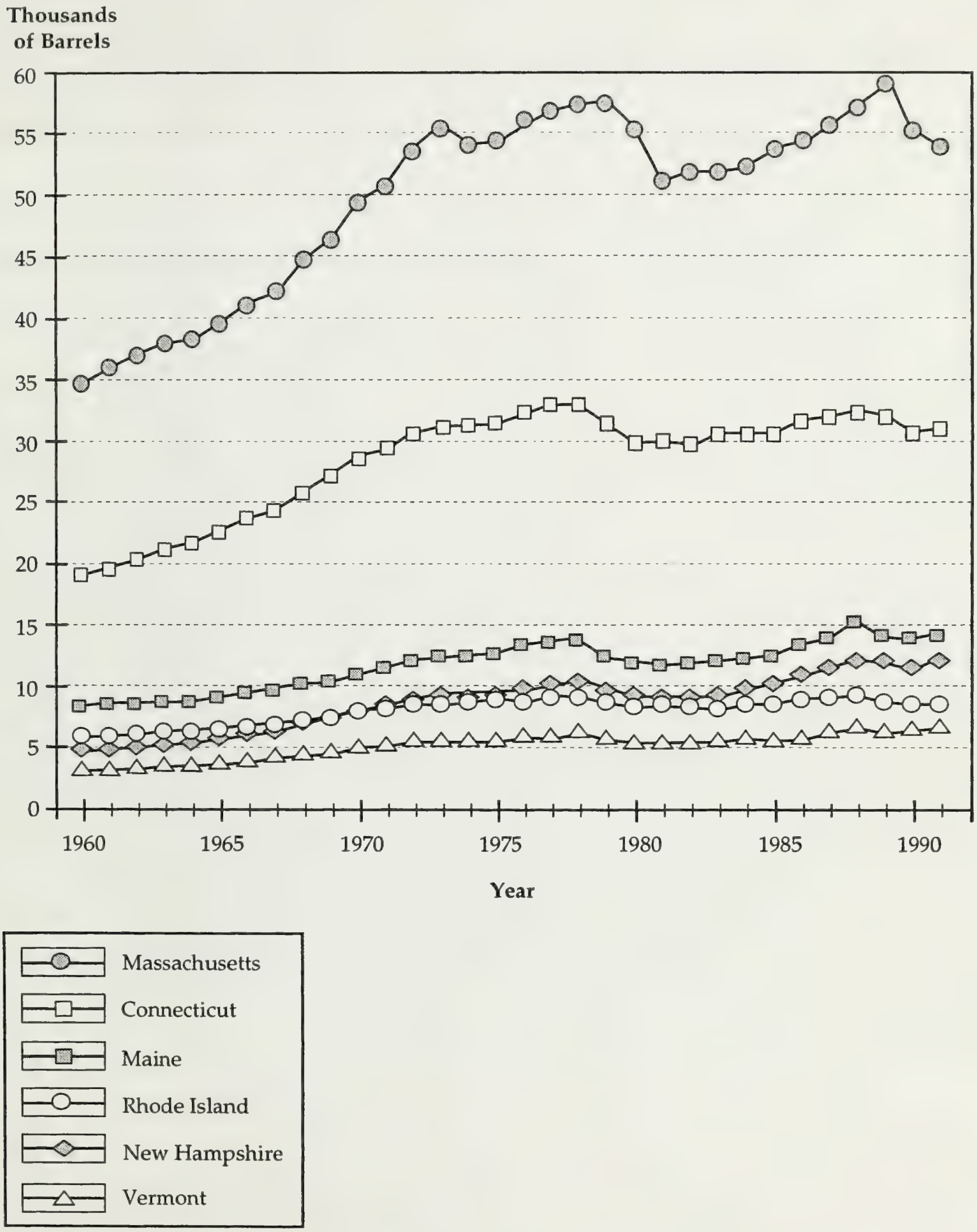


Figure 8.12 Historic Motor Gasoline Consumption



9.0 Other Environmental Issues

9.0 Other Environmental Issues

9.1 Trends in the Environmental Framework for Transportation Decisions

In the New England region, a high level of awareness and concern for quality of life are coupled with a growing awareness and concern for the quality of the region's air, land, and waters. What affects the environment ultimately affects residents and visitors both directly and indirectly. For example, the cumulative loss of coastal wetlands is linked to the decline in fisheries that affects the economy food choices of consumers, and the human environment of coastal communities, both aesthetically and culturally. The Corps of Engineers' natural valley flood storage program targets freshwater wetlands as an important resource to control flooding and thereby preserves habitat and open space. This relationship between quality of life and key ecosystems and the public concern that is being expressed about this relationship have increasingly important implications for decisions about transportation.

Environmental regulations, designed to protect the environment, have long been a component in transportation decisions. Laws such as the National Environmental Policy Act, the Clean Water and Clear Air Acts, and other statutes discussed in the Inventory Report, have been applied to transportation projects for decades. These laws have served to guide locational decisions and to stipulate mitigation requirements based on individual project-specific and site-specific impacts. Until now, this approach has been considered an adequate and appropriate one for protecting the environment.

Recently, the impacts of transportation projects have been undergoing greater scrutiny, with new emphasis on encouraging use of alternative modes of travel. More is now understood about the broad scope of transportation project impacts, including their air quality, energy, and land use implications (which are addressed in other sections). From air quality, to energy consumption, to runoff affecting water quality, to waste disposal, to land use patterns, many aspects of the environment are affected by cumulative transportation decisions. Although the impacts are not necessarily different today than in the past (and in most cases substantially less than in the era prior to environmental regulations), both the interrelatedness of the issues and how individual impacts incrementally add up to broader impacts are better understood. (For example, regulations which require full replacement of lost flood storage were enacted to prevent the cumulative, sometimes catastrophic, impact of many small incremental losses.) What is also different today is the dwindling supply of resources, many consumed by the secondary development impacts of infrastructure improvements, and a resulting increase in the marginal utility which society attaches to each incremental loss of environmental resources and the reduced marginal utility of each incremental gain in mobility.

Environmental and transportation policy are beginning to respond to these trends in knowledge and values.

Environmental regulation of transportation projects has traditionally been on an individual project and site-by-site basis. The Environmental Protection Agency has, since its creation in 1970, generally used this so-called "end-of-the-pipe" approach. EPA in its publication, "Planning Our Third Decade," notes the success of this approach in meeting past needs. The key word here is "past." EPA states that this approach is not and will not be enough to handle future environmental challenges. Instead of addressing environmental protection "one statute at a time," EPA is now striving to assess environmental problems comprehensively and to create environmental management processes that initially prevent both release of pollutants and the loss of resources. The growing emphasis on preventing impacts rather than mitigating them extends to the planning of transportation projects. Greater cooperation by state and federal resource protection agencies is welcomed by state transportation officials as a means to improve the regulatory process, but may also imply a broadening of the concerns that go into the process.

Recent federal transportation related legislation, including ISTEA and key provisions of the Clean Air Act, as well as some state transportation legislation (such as Maine's Sensible Transportation Policy Act) is also increasing emphasis on a policy of prevention.

One of the keys to the new policy trend toward environmental prevention is an examination of alternatives. Questions asked include, "Do we need this project? Is there another way of meeting its objectives? " This approach has perhaps the greatest implication for transportation. The quest for greater mobility and convenience has been cited as a key component in making transportation decisions. The new approach to environmental policy uncouples the objective of mobility from the assumption that improved mobility can only be provided by the automobile.

Transportation policy has begun to reflect this trend in environmental policy. ISTEA, for example, requires that transportation decisions be made after giving consideration to, among other things, community quality, environmental protection, economic efficiency, and energy conservation. ISTEA includes incentives to manage transportation demand and allows funds previously limited to highway projects to be spent on other modes of surface transportation. In addition, ISTEA not only permits but mandates spending 10 percent of funds on "enhancements," such as scenic highway landscaping, bike paths, and renovation of historic train stations, projects which directly improve quality of life and support transit, bicycle, and pedestrian modes. These aspects of ISTEA set the stage for furthering the incorporation of environmental quality into transportation planning with a shared goal of preventing negative impacts.

Another key to preventing degradation of environmental quality is early and continual identification of important and sensitive resources, independent of specific projects if possible, so that it is clear which resources require protection before in-depth project study. For example, the EPA and state of Massachusetts have coordinated on an eco-regions study for southern New England that will identify important resources. If such resources are identified prior to project definition, then the potential for protecting those resources is increased. Transportation professionals can then use the resource base (with tools such as

GIS) to identify sites which are more sensitive to the environment, opposed to the process in which sensitive resources may not be identified until the environmental impact assessment. Even if the ideal of prior resource inventory is not fully met, current technologies permit field location of wetland boundaries and other sensitive features during preliminary transportation corridor reconnaissance. Finally, the idea of mitigation prior to impact, as exemplified in the wetland banking recommendations of the Corps and other agencies concerned with wetland preservation, can be further extended to acquisition of sensitive area (or their development rights) as a means to mitigate in advance the growth which may result from transportation improvements.

The concept of prior analysis of the natural resource base is representative of thinking within the environmental community that natural boundaries, as defined by units such as ecosystems and watersheds will become stronger influences in future environmental decisions. Ecosystems will be viewed as the primary resources to protect rather than the component parts defined by specific regulatory frameworks. This suggests subregions defined in terms of natural resources (which function as wholes) will be given greater weight in comparison to regions which are defined by economics, demographics, or politics. It is not clear how this issue of overlapping natural and institutional boundaries will be resolved, but some instances of this trend currently exist. For example, towns on both sides of the Connecticut River are included in a regional planning commission providing input to transportation planning in Vermont and New Hampshire.

A related policy concern is the role of land use as both a major factor and result of transportation decisions. As noted above, the land use aspect of transportation is responsible for a major share of the changes on the natural environment and quality of life which have given rise to these policy trends. Land use is discussed in the following section.

In summary, environmental policy is shifting toward identifying key resources ahead of time, assessing resources comprehensively and with respect to natural functions, and emphasizing preventative strategies to manage environmental quality. The expectation of this environmental policy is that transportation projects should respect and support these efforts through an examination of transportation alternatives, consideration of intermodal tradeoffs and intermodal combinations and increased efficiency in the design and management of transportation systems to reduce the need for additional capacity.

9.2 Land Use

Future land use trends in New England will be driven by a number of factors. The most important factors are likely to be the region's economic conditions, public land use policy, investments in transportation infrastructure, existing land use patterns and environmental constraints. Each of these factors has influenced development patterns in the past, and will continue to do so in the future to varying degrees.

Economic growth is the fundamental generator of new development. Because existing land use represents the cumulative result of all past growth, the increment represented by new growth is relatively small in comparison, and overall land use patterns will change incrementally and slowly. Public policy will give shape to how future development occurs. As described below, some efforts are taking place in several of the New England states to guide development. Transportation infrastructure, existing land use patterns, and environmental constraints (such as wetlands) will influence where development occurs, and to some extent its type: both market forces and public policy pull development to locations with good access and positive relationships to nearby land uses, and push it away from land use conflicts and areas with regulatory constraints.

The policies and programs being addressed by NETI address the transportation element; in addition, the scenarios being developed and evaluated by the study can make assumptions regarding policies affecting land use, which may in turn affect the demand and service characteristics for transportation improvements.

During the 1980s, an economic boom fueled the growing and popular land use pattern which is now commonly referred to as sprawl. This pattern of dispersed development became much more widespread after World War II, owing particularly to the greatly increased mobility that was made possible by increased automobile ownership. While large tracts of new single family housing, for which Levittown was the model, were actually rather dense by today's standards, there was an increasing trend toward larger lot sizes, pushing development to tracts of open land at and beyond the urban fringe. (Among the motivations for larger lot size requirements were to reduce the rate of growth in dwelling units and to increase the value of new real estate, reflecting municipal financial considerations.) The soaring post World War growth rate supported this pattern of development spreading out from the urban cores into undeveloped, wide open areas in smaller communities. Over the same period, numerous industries and retail businesses followed the trend toward dispersed land use patterns. Development expanded rapidly up and down existing roads, spilling over onto new roads and surrounding highway interchanges built just to accommodate the market. These changes were particularly noticeable in the less developed parts of the region in the 1980s as the development boom reached much of the region. As discussed in the NETI Inventory Report, commuting trips became less concentrated on city centers, involving many-to-many origins and destinations and increasing vehicle miles traveled at a rate faster than population growth.

Public policy generally supported the dispersed growth pattern, but eventually, concerns such as loss of community character, environmental impacts, and increased congestion arose. As these concerns grew, communities and states, began to question the acceptability of sprawl as a continued land use pattern. At about the same time, the economic boom of the 1980s came to an abrupt halt, and development all but ceased throughout New England. As a result, over the last several years since the boom, there has been a public policy debate regarding the issue of sprawl and the desirability of managing growth in a more orderly fashion and at the level of states or sub-state regions. This debate has many sides, as might be expected. While there is growing emphasis on concentrating development in already developed areas, and constraining the market-driven land use decisions, it is clear that there are, and will continue to be, many proponents of public

policy that continues to give primacy to municipal home rule, market forces, and property rights.

Which way will future development patterns trend? One way of answering this question is to look at existing developed areas and project how new development might be accommodated. For the purpose of this discussion, there are four general types of developed areas in New England: the major urban areas (e.g., Boston, Hartford, Providence); the smaller urban areas (e.g., Portland, Burlington, Portsmouth); the suburban areas (outside the urban centers and denser inner communities); and the rural areas. Potential future land use trends may be considered for each one of these. In general, the urban, more developed areas are likely to offer the greatest possibility for continuing and expanding the concentration of development. (For example, in the Boston region, the Metropolitan Area Planning Council is accepting nominations for concentrated development center (CD.C.) designation, many of which coincide with existing urban centers.) The suburban and rural areas, on the other hand, are more likely to continue a dispersed pattern: even if more instances of compact development should occur, most of them will be relatively small and located sufficiently far apart that for the purposes of transportation planning, the regional pattern of growth will remain highly dispersed unless specific sub-state regional policies are brought to bear. (The local benefits of even scattered compact development areas that can provide a better basis for multi-passenger service to workplace or shopping centers should not be discounted, however.)

The major urban areas, which are already built up, can be expected to see new development take place in the form of infill and through redevelopment of some sizable parcels of land previously in outmoded industrial, commercial or transportation uses. Taking down existing buildings and putting new ones up, or filling vacant or underutilized parcels with new development can result in increased density. As such, the land use pattern of concentrated urban development can be expected to be intensified in the central portions of major metropolitan areas. Planned development in South Boston, Massachusetts, with related transitway service, is an example. In the smaller urban areas some new development will also occur as infill and redevelopment in the core areas, with additional new development in the immediately adjacent fringe areas. These fringe communities are in many cases significant concentrations of employment, and in some instances are served by public transportation. According to economic projections reported in the NETI Inventory Report, these smaller urban areas are expected to see the largest increases in population density, along with the suburban areas. The land use pattern of moderately dense urban development, surrounded by medium density communities will thus likely continue. The urban fringe communities are the places where there is likely to be an increase in density, both on vacant land and through redevelopment of marginal commercial and industrial sites. Already adjacent to the urban core, and having greater density than the suburbs, these communities will experience pressure for accommodating growth, potentially adding more development to the edges of already developed areas.

The outer suburban areas are typically bedroom communities outside the major and smaller metropolitan core areas. They are often not served as well or at all by public transportation, but may have good connections to interstate and other major highways. New development is most likely to continue the pattern of dispersed development, with some attempts towards, but probably less likelihood of, achieving a more compact

development pattern. For example, economic recovery in 1993 has rejuvenated the housing market in Boston, resulting in a large number of residential building permits in the Route 495 ring of outer suburbs located approximately 25 miles from the core. Retail development pressure is also directed primarily at suburban locations. The suburban land use pattern satisfies a number of consumer wants and local preferences and is likely to be with us for the foreseeable future. It is the pattern of choice for many individuals. The idea of greater density in the suburbs is counter to one of the reasons for their existence – a desire to get away from the density of the urban areas. On the other hand, suburban development progressively alters the community character and quality of life which attracted development in the first place, leaving subdivisions which were once at the exurban fringe surrounded by similar subdivisions in communities that have become more populous and served by roadways that are increasingly congested.

Rural areas are most likely to see new development as a continuation of the low density development pattern, with the possible exception of an occasional new node, such as the recent proposal for a casino and four-season resort at the former Loring Air Force base in northern Maine. In rural areas, there is ample land, and little influence from central concentrations of existing land uses. Thus, if soils are adequate for wastewater disposal, the roadway infrastructure is usually the key factor in location decisions. Houses are developed on both small and large parcels of land in a highly dispersed pattern that generates commuting trips to distant employment sites. Retail development often takes the form of a series of individual establishments strung out along the roadway frontages or adjacent to limited access highway interchanges. Interchanges become more central to the subregional transportation network than the traditional city and town "central places." Large sites with this good highway access to all parts of subregional markets become the favored locations for shopping malls and big-box stores such as Walmart, often threatening the survival of traditional retailing in the town centers, as recently exemplified by development controversies in St. Albans, Vermont and Greenfield, Massachusetts. The quality of life in rural New England may be more threatened by these changes than in either the suburbs or the metropolitan core areas. Historic town centers will change as their retail base is lost to development at highway interchanges, and the experience of traveling through open country will change as development occurs along the roadways which connect towns. Examples are common in the rural parts of all six New England states.

An additional consideration in evaluating these development patterns is environmental impact. Infill and redevelopment in urban areas generally has little or no impact on wetlands and may be a means to remediate soil contamination, while suburban and rural development is more often on open land on which wetlands protection is an issue. As New England upland is developed, wetland regulations become a consideration pushing additional development further away from developed areas which may have available well-drained farmland or other available upland. Finally, in rural areas, the loss of farmland to development contributes to a change in the quality of life both by changing the economy and through visual impacts to views which are highly prized by both natives and tourists alike.

It remains possible that public policy could begin to effect a shift towards a greater concentration of development, if the current debate is concluded in that direction; the

alternative is to continue the current trends as described above, potentially with improvements in quality through performance standards and measures such as cluster zoning that maintain overall densities at the site level but arrange the development in a manner that is more sensitive to site constraints. If a policy of more compact development were adopted in any area, there would not be any immediately dramatic change in overall land use patterns, however, because these patterns develop slowly and incrementally, and most of what will exist in the year 2020 has already been built.

For such a change in development trends to occur, the policy has to come first, then its implementation. New currents in public policy towards land use are just now becoming discernible in each of the six New England states. Although all of the states are considering the issue, each one is taking a slightly different approach.

Connecticut. Policies articulated in the 1992-1997 Conservation and Development Policies Plan emphasize concentrating new development in transit-accessible locations. Because of the existing pattern of development, these locations tend to cluster around existing highway corridors. The Plan contains a development priorities matrix which places the highest priorities of development in the existing urban centers, with immediately adjacent, less dense areas receiving second priority. The Griffin Corridor light rail proposal, from Hartford to Bradley Airport, currently under environmental review, might be the spine of a regional development corridor, serving intensively developed areas near Hartford as well as low density suburban and semi-rural areas. While this project could potentially collect development at the regional level, it could also create scattered medium density pockets of development on agricultural land; it is an instance where transportation should be coordinated with regional and local land use policy.

Maine. The 1988 Maine Growth Management Act calls for, among other things, the designation of growth areas and rural areas. The intent is to guide growth to already developed, or developing areas, to conserve resources and help preserve the remaining woods, fields, open space, and other quality of life features. Almost half of Maine's communities have developed or are in the process of developing Comprehensive Plans under the law, which, however, has been weakened recently due to funding constraints.

Massachusetts. Investment in transportation infrastructure is viewed by the present Administration as an effective tool in guiding land use and development. For example, Worcester's downtown redevelopment effort is supported by the state's financial commitment to the Route 146 Project, which will link downtown Worcester more directly to the Massachusetts Turnpike, and the Gateway Program, which includes funding for a rail-highway grade separation to enhance the private development of a major new medical center.

In addition to the designation of concentrated development centers in the Boston metropolitan region, as described above, Worcester is actively pursuing downtown revitalization and construction. Planning is underway for the civilian reuse of extensive land areas and buildings at Fort Devens, a small portion of which is an intermodal rail terminal which is linked to the Moran Terminal in the Port of Boston. The legislature is considering a major land use bill (the Massachusetts Planning and Development Act or

"Growing Smart" Bill), which would enable but not mandate regional land use planning and guidance of significant developments.

New Hampshire. There is no state policy regarding land use in New Hampshire. There has been some effort at the regional level, through the regional planning commissions, to look at land use policy, but very little has actually been developed. Land use planning is still very much a locally governed activity. The Pease Development Authority is actively pursuing the conversion of the former Air Force Base in Portsmouth/Newington to an International Tradeport, and airport-related development is also likely near Manchester Airport.

Rhode Island. The 1989 Land Use Plan encourages infill projects; (much is currently happening in downtown Providence). The Plan also encourages the development of contiguous growth areas with specified limits. It also recommends the development of new centers of development in areas which are not constrained by environmental factors. The implementation of these policies would result in a development pattern similar to that which exists currently, with a few pockets of new development and increased densities in existing developed areas. A potential center of new development is at the former Naval facilities at Quonset Point, where development is expected to occur in relation to a planned intermodal transportation center.

Vermont. Act 200 is Vermont's growth management law, aimed at concentrating development in already developed areas. Planning is undertaken at both the regional and local levels. The 12 regional planning commissions have or will soon complete their regional plans. Local plans then must be consistent with the regional plans. The state is funding a pilot project to test the growth center planning and designation provisions of Act 200. Vermont also directly involves regional planning agencies in transportation planning under ISTEA, providing a relatively strong opportunity to link transportation and land use decisions.

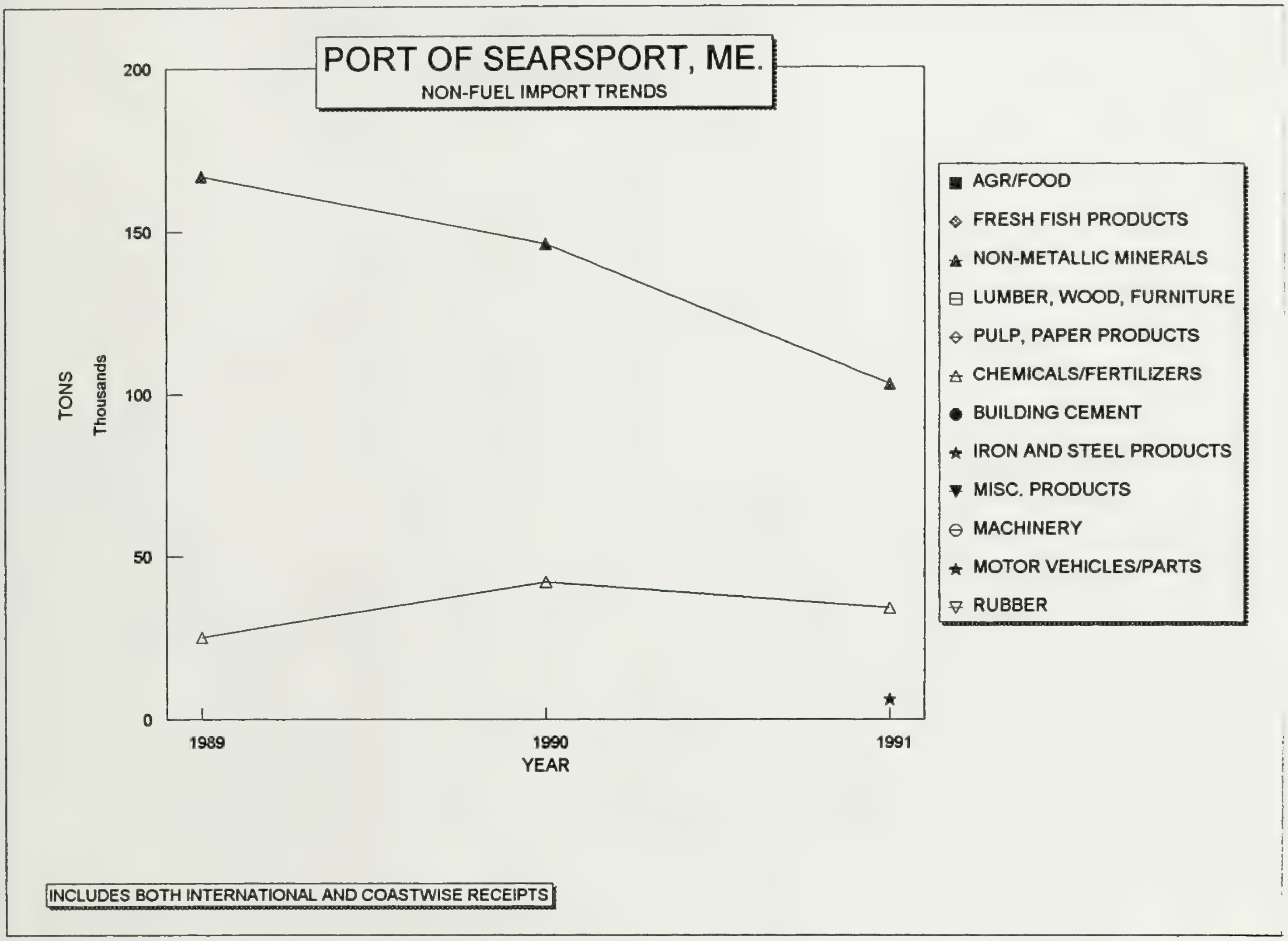
Even when the policy is in place, the action can be slow to follow, as is evident in all of the states. Actions depend on local governments (where most land use decisions are ultimately made), the economy, and the political process, among other things. Hence, public policy and the reality of land use patterns are quite far apart at this time.

One of the ways that new land use public policy is manifesting itself is in increased interest in the link between land use and transportation. Transportation investments clearly have a direct effect on land use patterns. For example, the circumferential highway that is being built around Burlington, Vermont is likely to stimulate more development in the communities it passes through. Similarly, if a new limited access highway in northern Maine is built, it too may create a new corridor for new development, away from existing developed areas. On the other hand, intercity public transportation concentrates induced development at station areas. The proposed Boston to Portland rail connection could help to stimulate development in downtown Portland, while providing an alternative transportation mode for traveling between the two cities. Similarly, the intermodal facilities at Fort Devens and Quonset Point could help to generate development in a compact area. These examples represent the potential for transportation to lead the way in helping to change land use patterns.

Also playing a part in future land use trends will be existing land uses, which represent the majority of the future land uses. However, while existing land uses attract new development, it is projected that the northern areas of the region will grow faster than the more extensively developed southern areas, in part because of the availability of land and possibly quality of life factors. This shift represents a potential land use trend, with implications for transportation investment decisions. The southern areas have developed to a large degree because they are best served by the current transportation network. What transportation system improvements are appropriate for the developing northern areas? An opportunity presents itself for looking closely at a range of the options and working towards integrating them to serve land use and promote sound land use decisions.

Appendix

Port-Specific Trends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150
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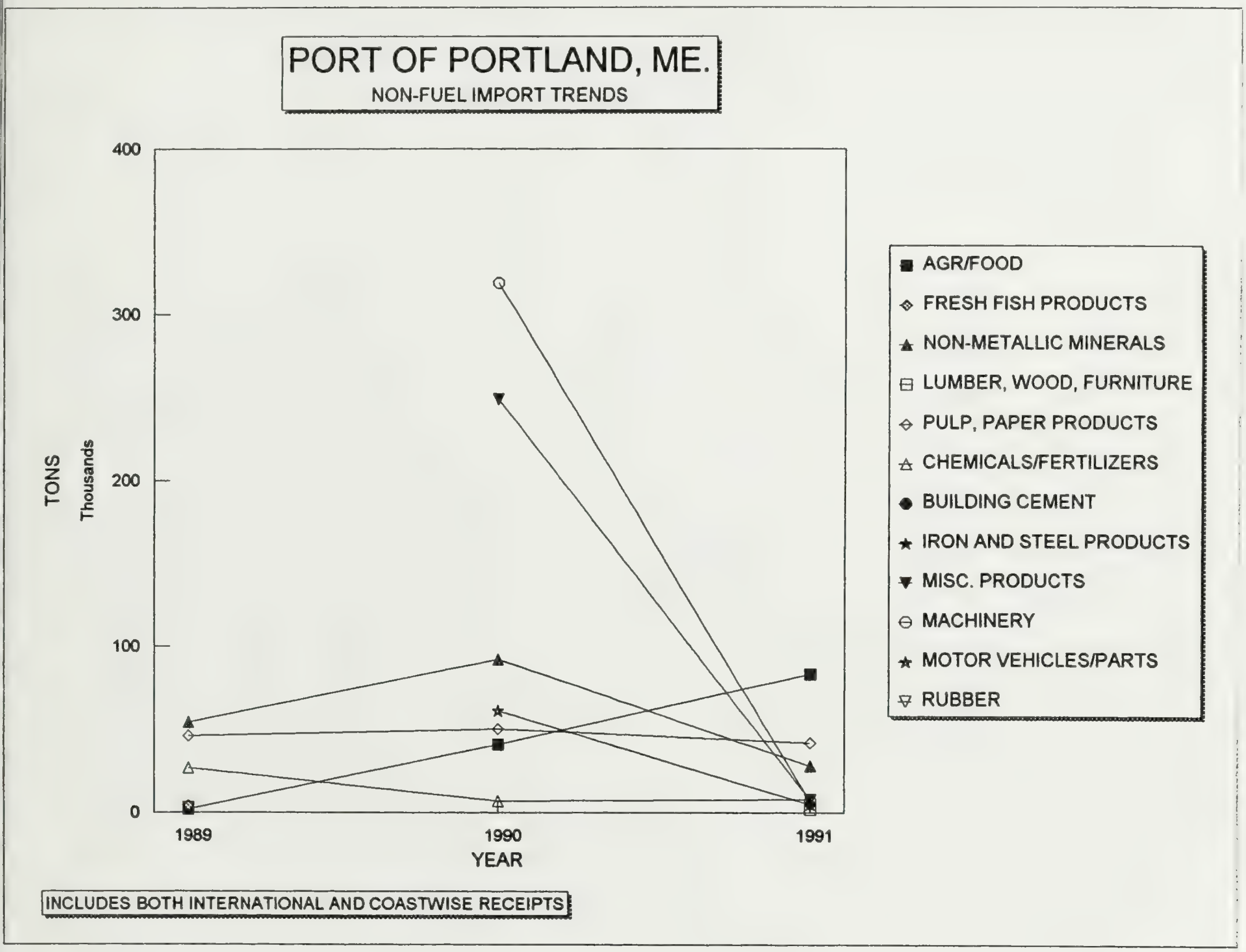
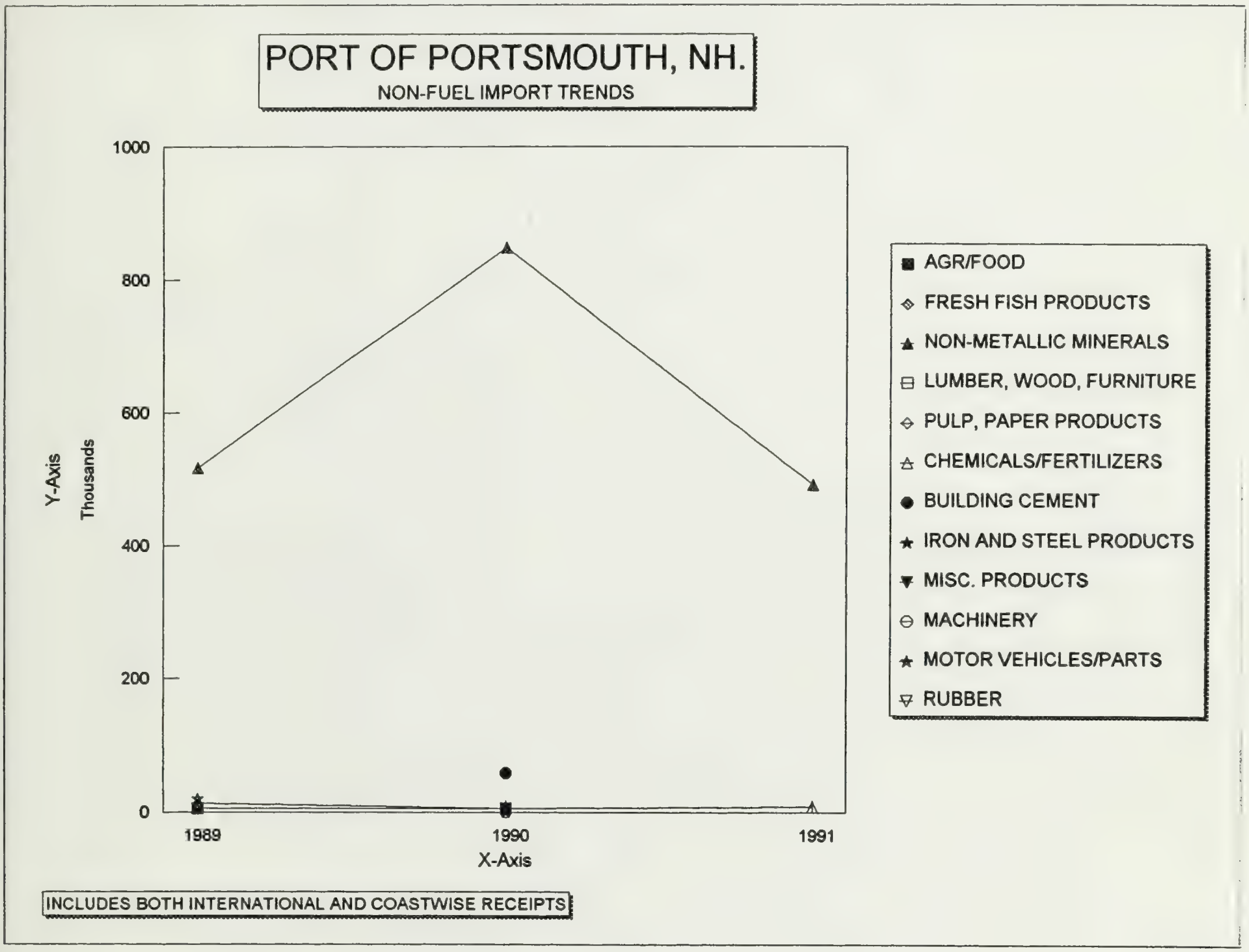
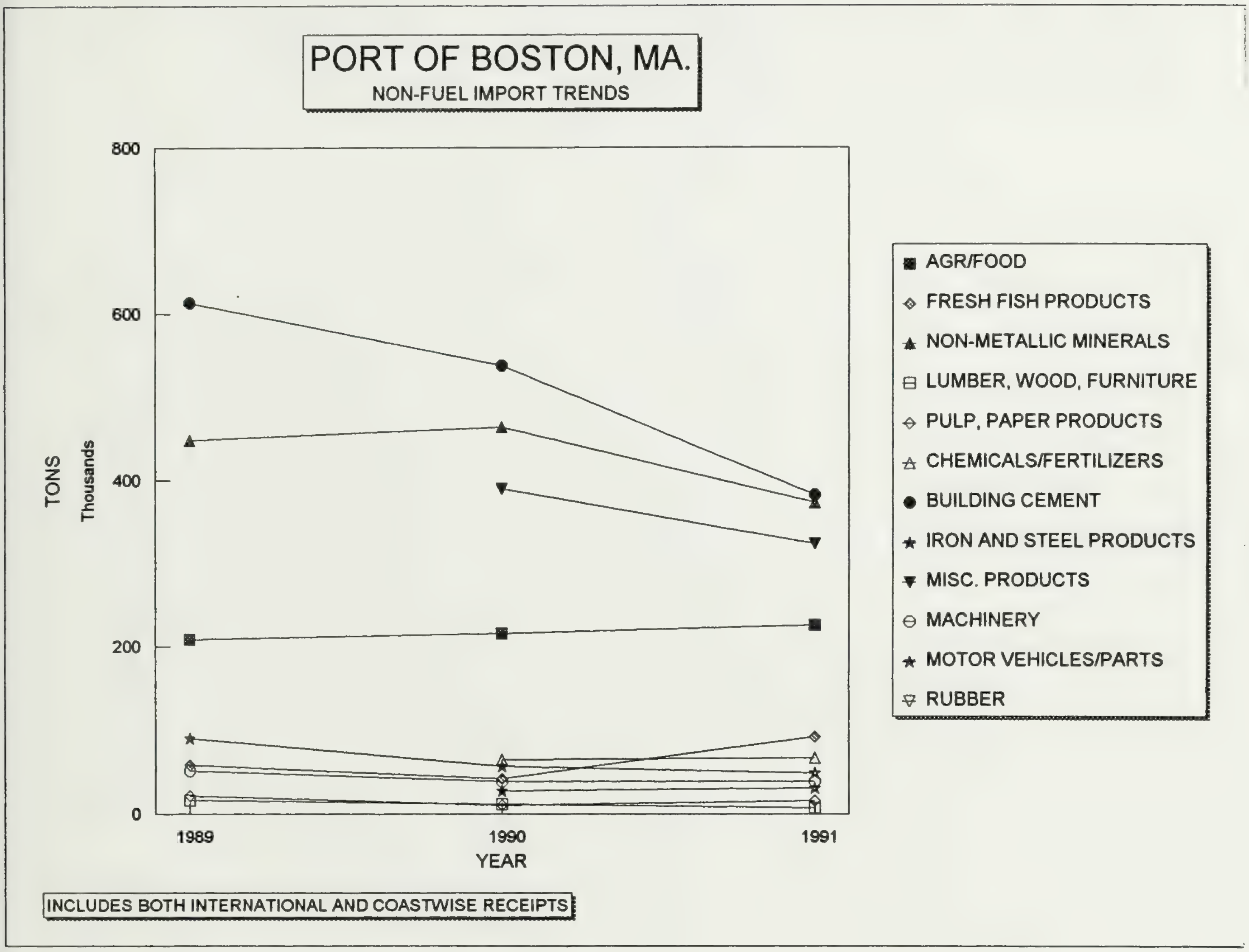
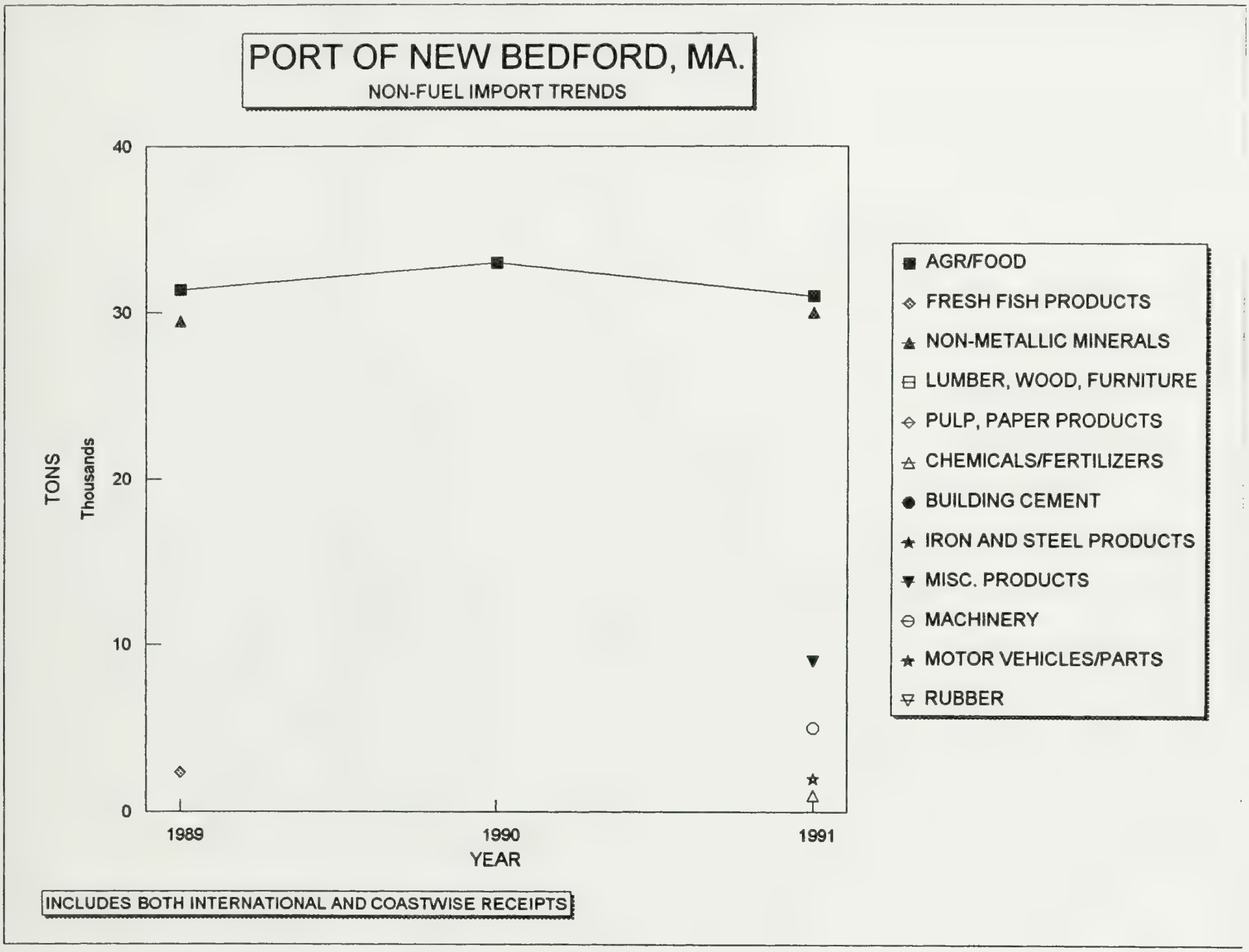
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS

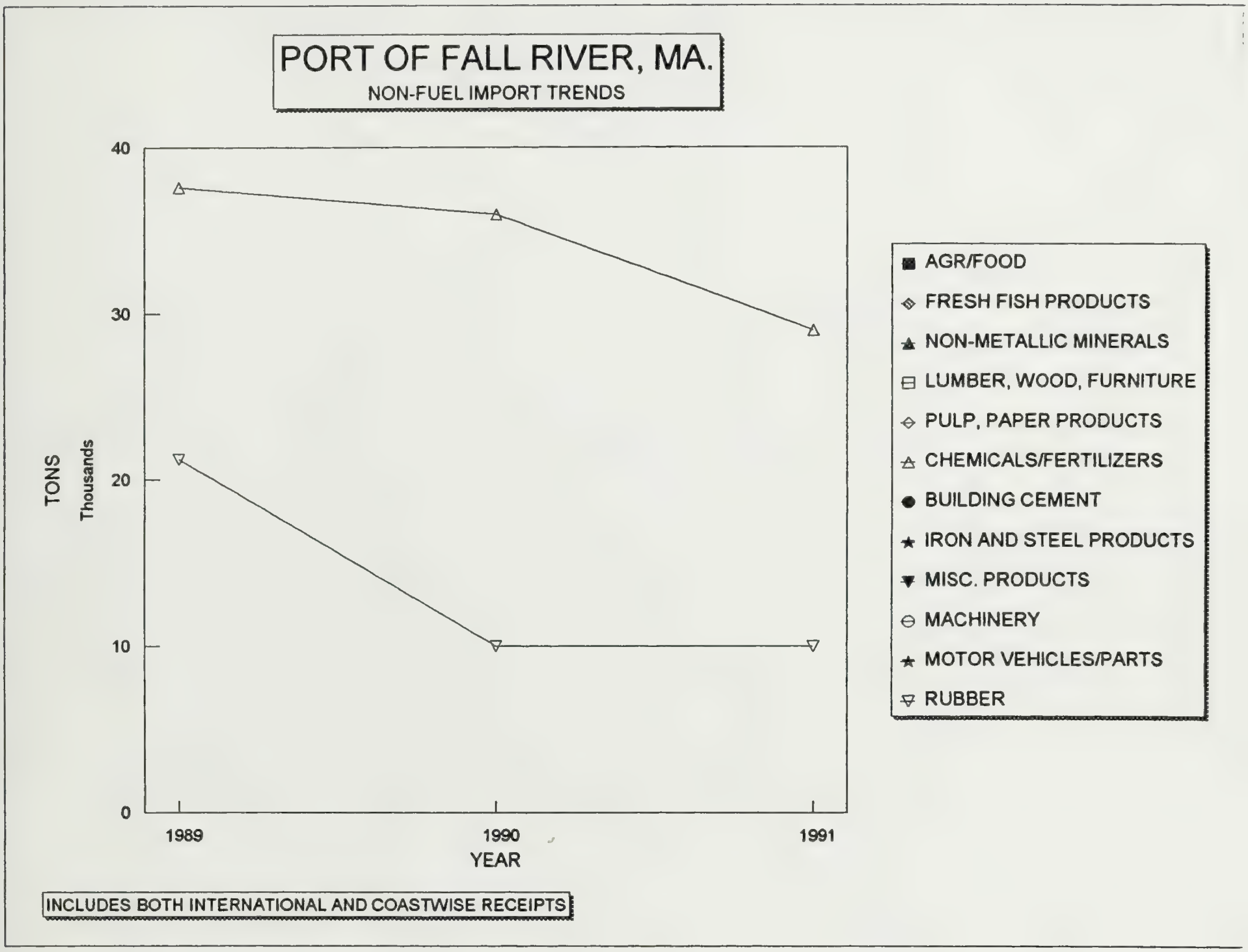

PORT OF PORTLAND, ME.
NON-FUEL IMPORT TRENDS
400
300
200
100
0
TONS
Thousands
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS

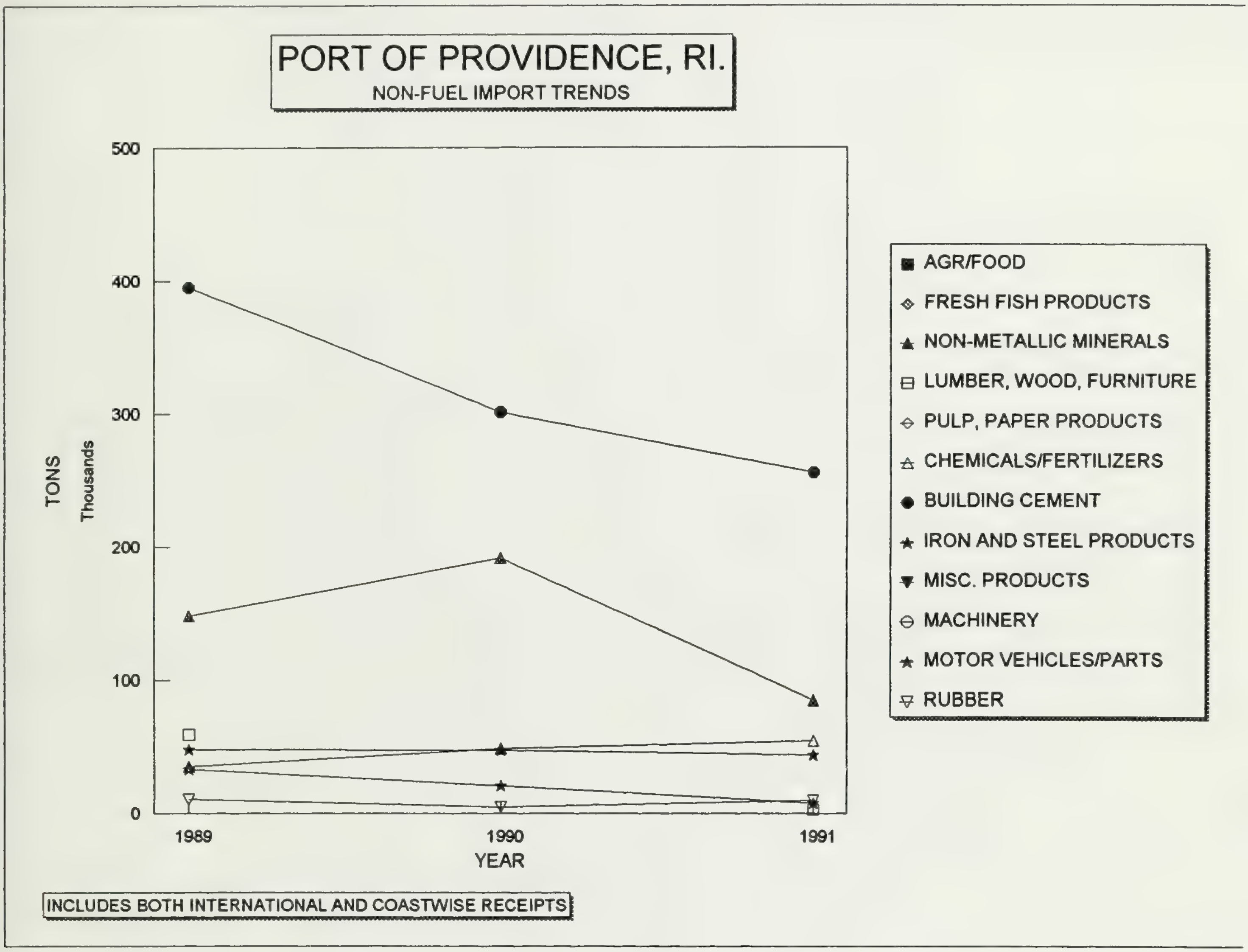

PORT OF PORTSMOUTH, NH.
NON-FUEL IMPORT TRENDS
1000
800
600
400
200
0
Y-Axis
Thousands
1989
1990
1991
X-Axis
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS

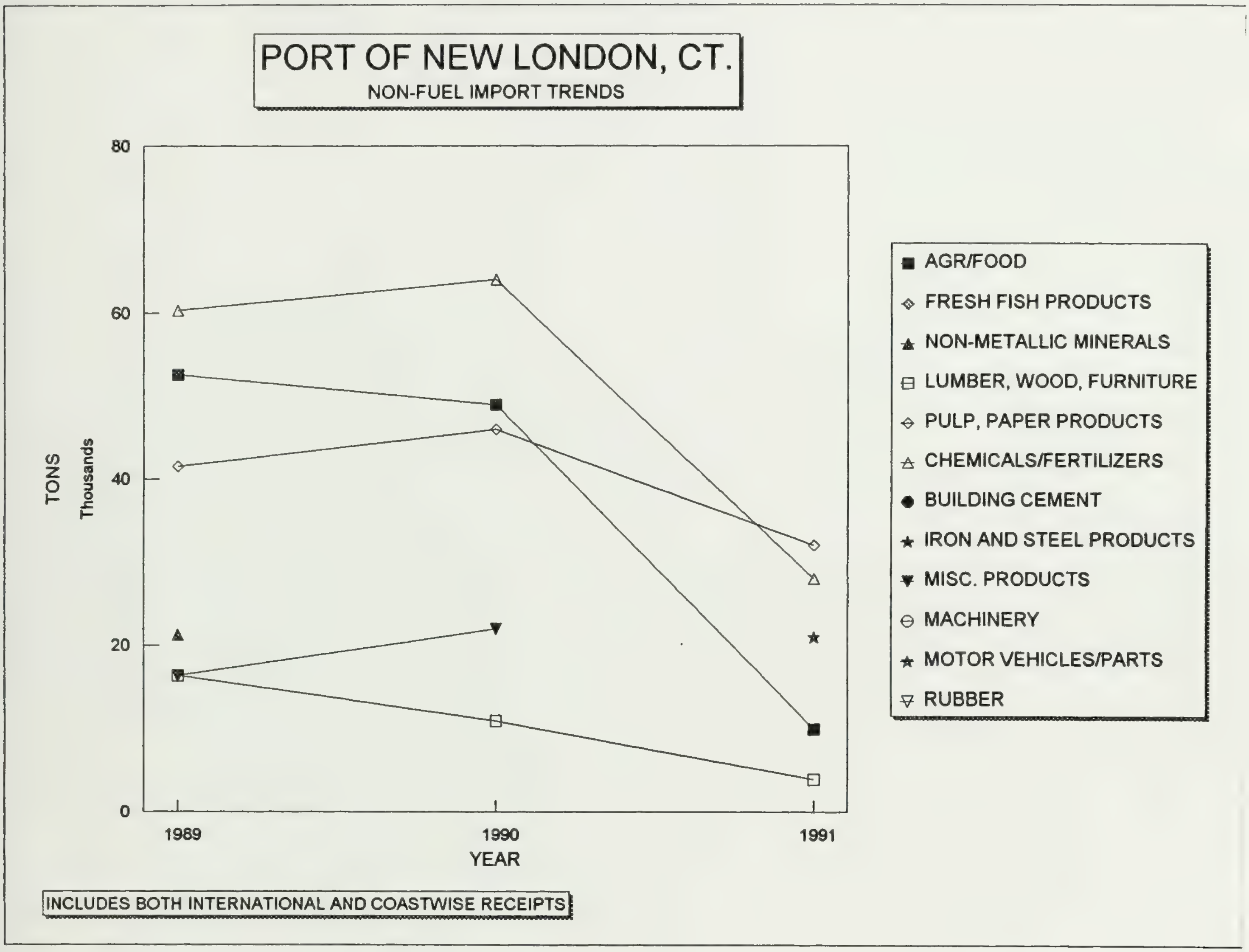

PORT OF BOSTON, MA.
NON-FUEL IMPORT TRENDS
800
600
400
200
0
TONS
Thousands
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS

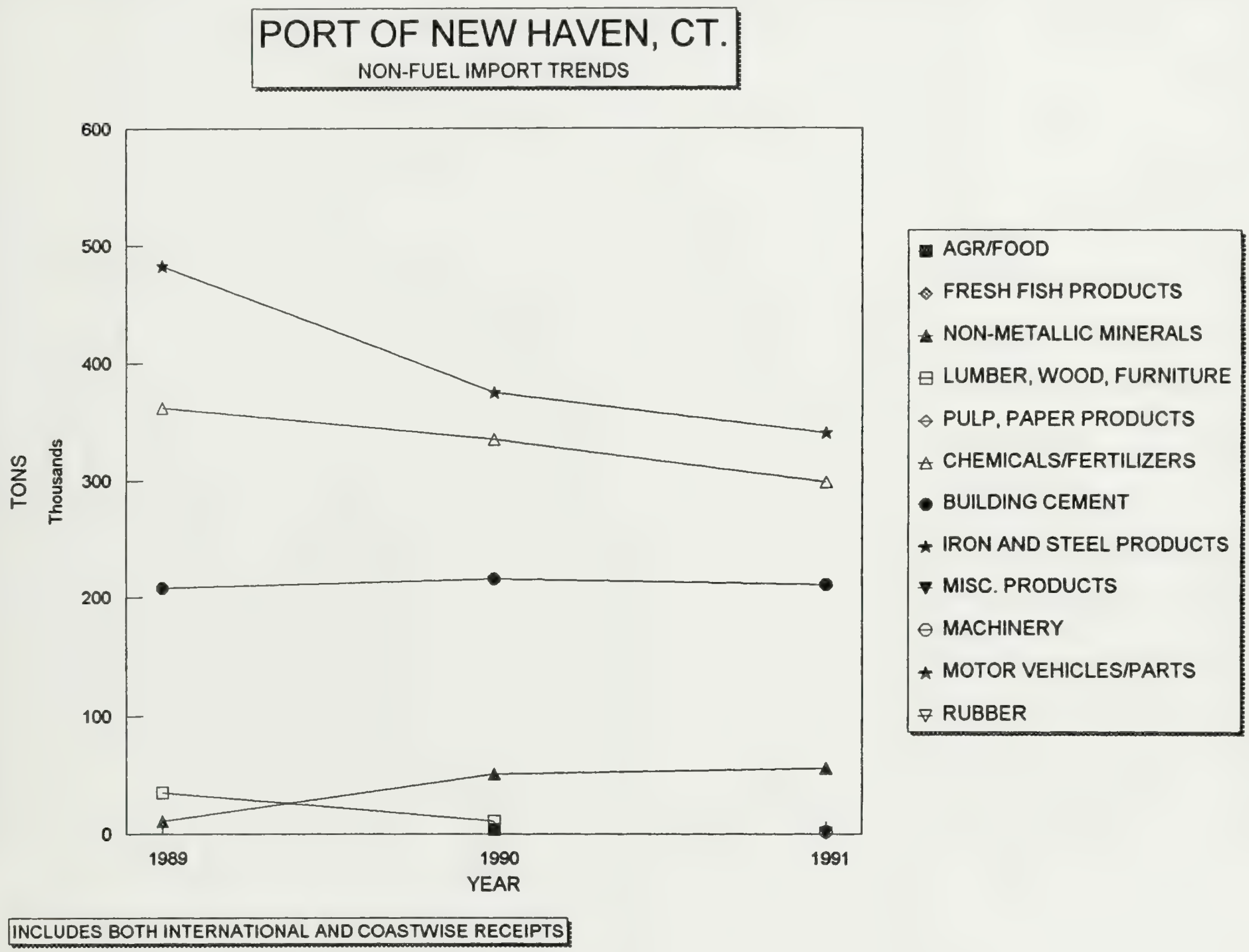


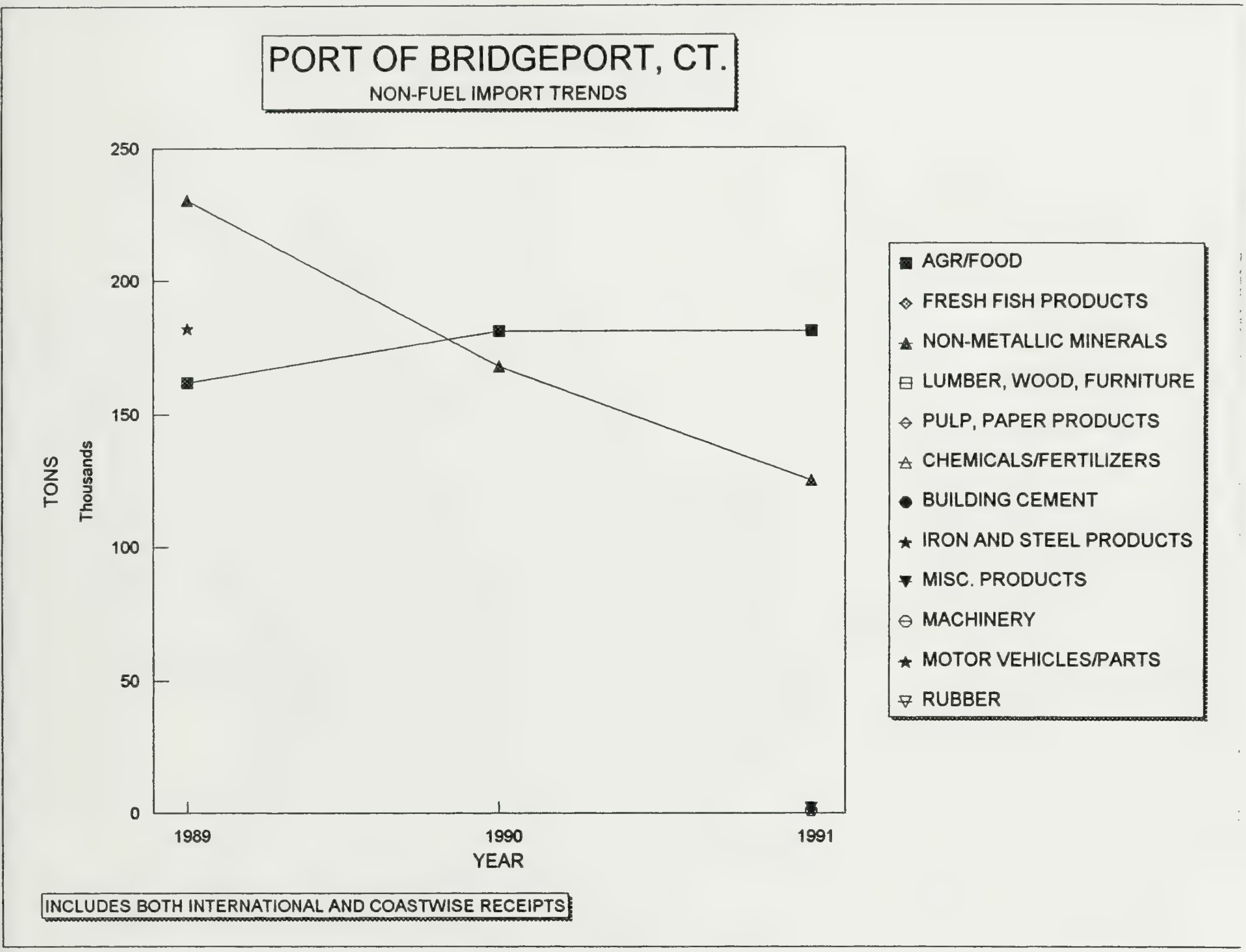
PORT OF NEW BEDFORD, MA.
NON-FUEL IMPORT TRENDS
40
30
20
10
0
TONS
Thousands
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS

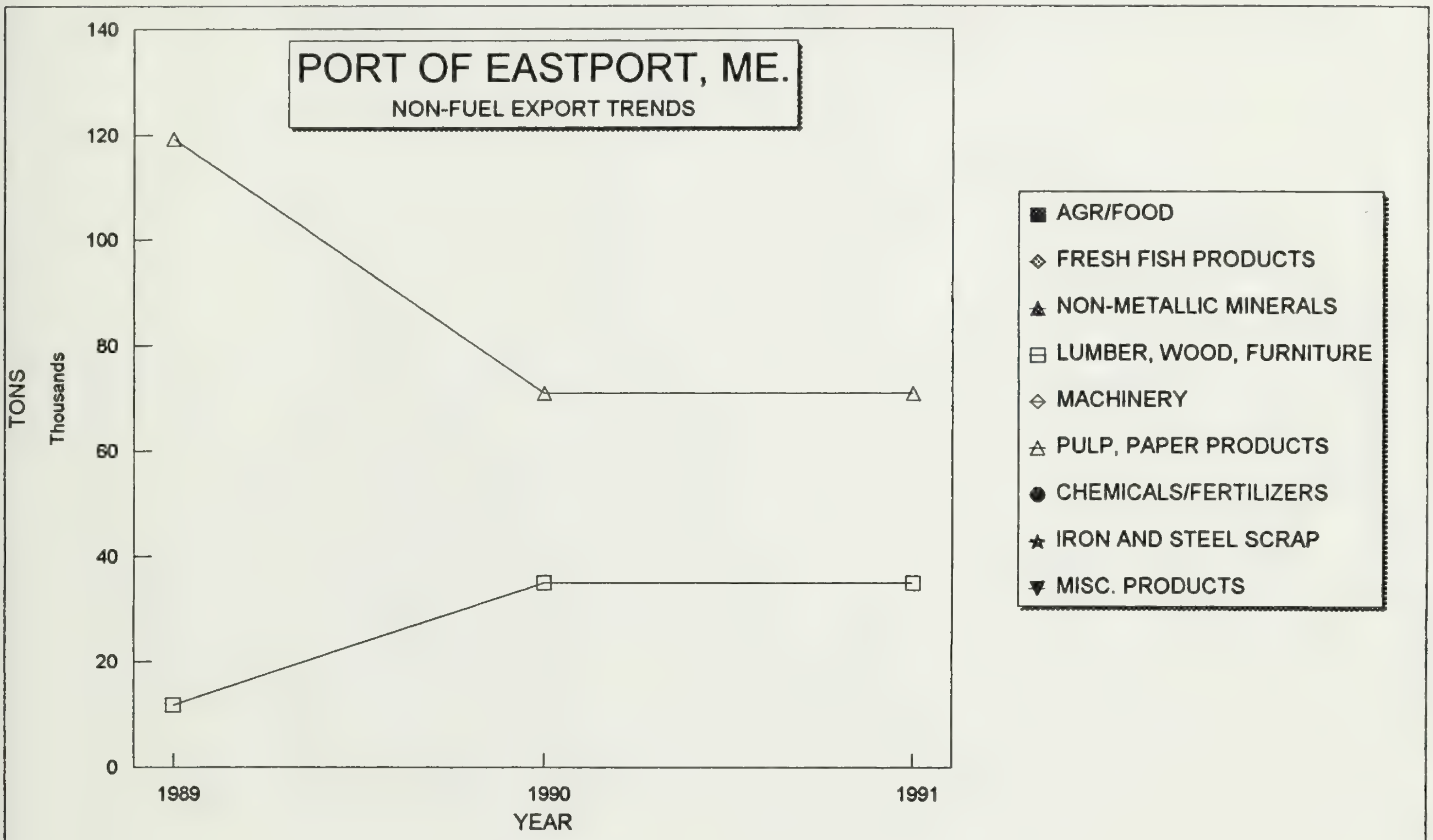

PORT OF FALL RIVER, MA.
NON-FUEL IMPORT TRENDS
40
30
20
10
0
TONS
Thousands
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS


PORT OF PROVIDENCE, RI.
NON-FUEL IMPORT TRENDS
TONS
Thousands
500
400
300
200
100
0
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS

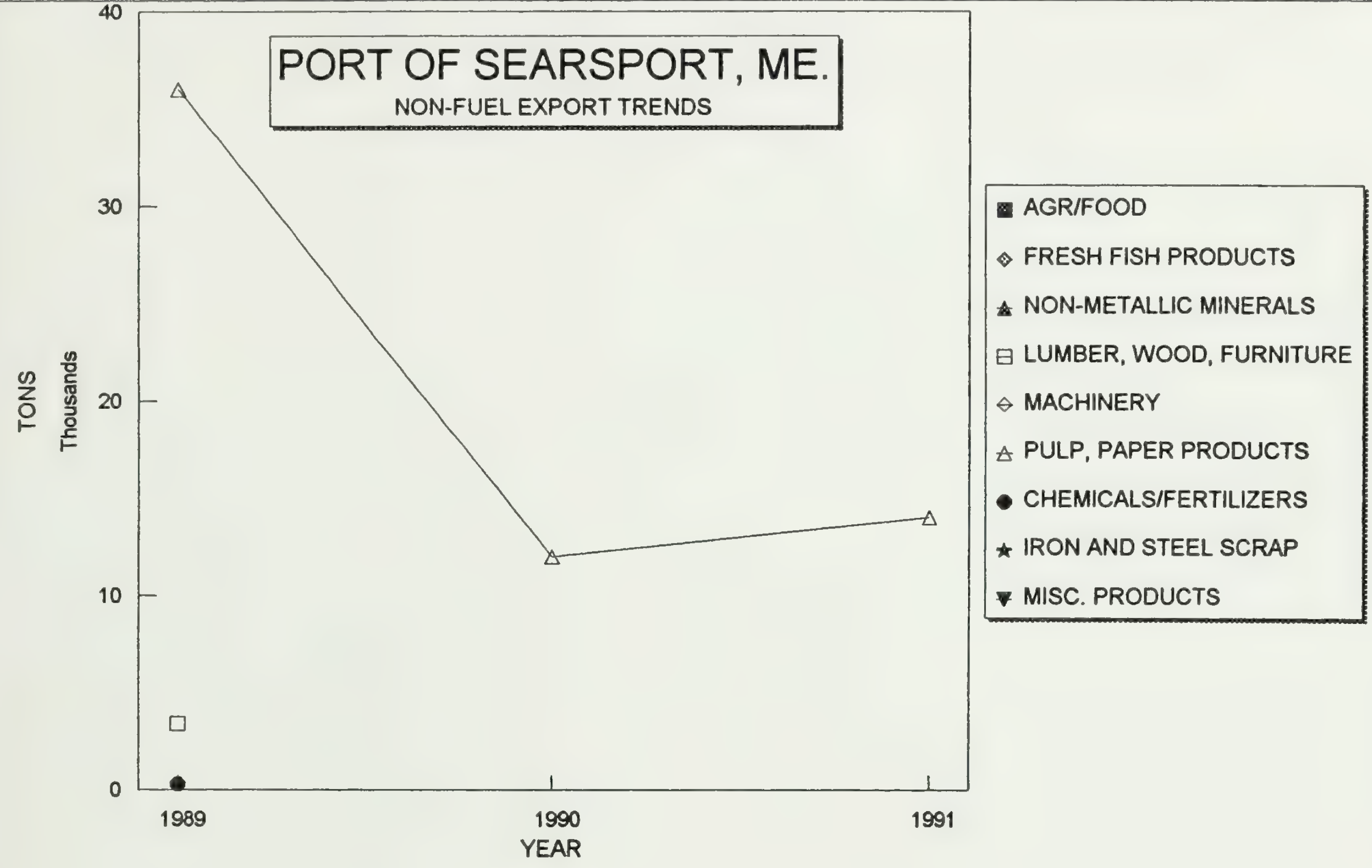

PORT OF NEW LONDON, CT.
NON-FUEL IMPORT TRENDS
TONS
Thousands
80
60
40
20
0
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS


PORT OF NEW HAVEN, CT.
NON-FUEL IMPORT TRENDS
600
500
400
300
200
100
0
TONS
Thousands
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS

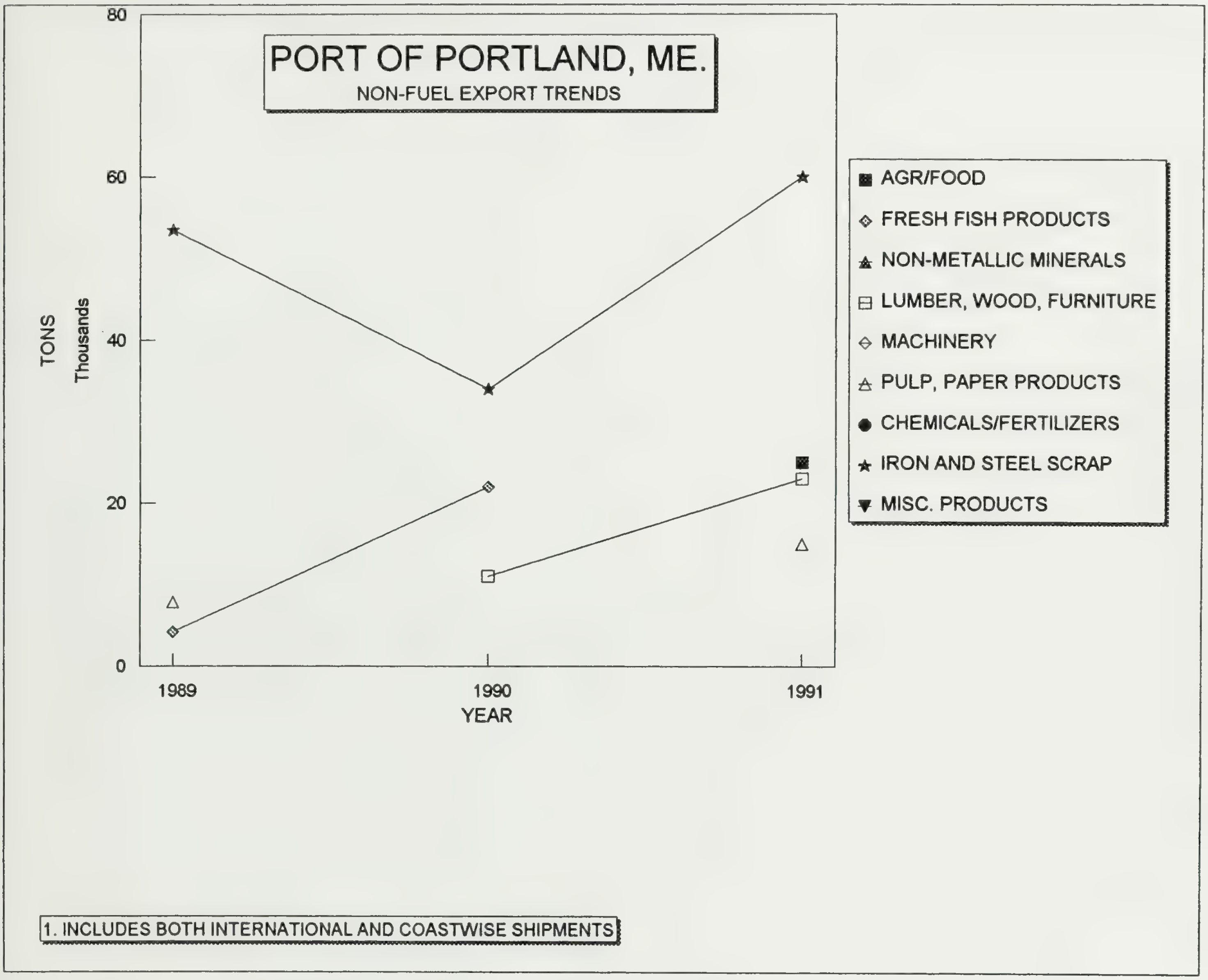

PORT OF BRIDGEPORT, CT.
NON-FUEL IMPORT TRENDS
TONS
Thousands
250
200
150
100
50
0
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
BUILDING CEMENT
IRON AND STEEL PRODUCTS
MISC. PRODUCTS
MACHINERY
MOTOR VEHICLES/PARTS
RUBBER
INCLUDES BOTH INTERNATIONAL AND COASTWISE RECEIPTS



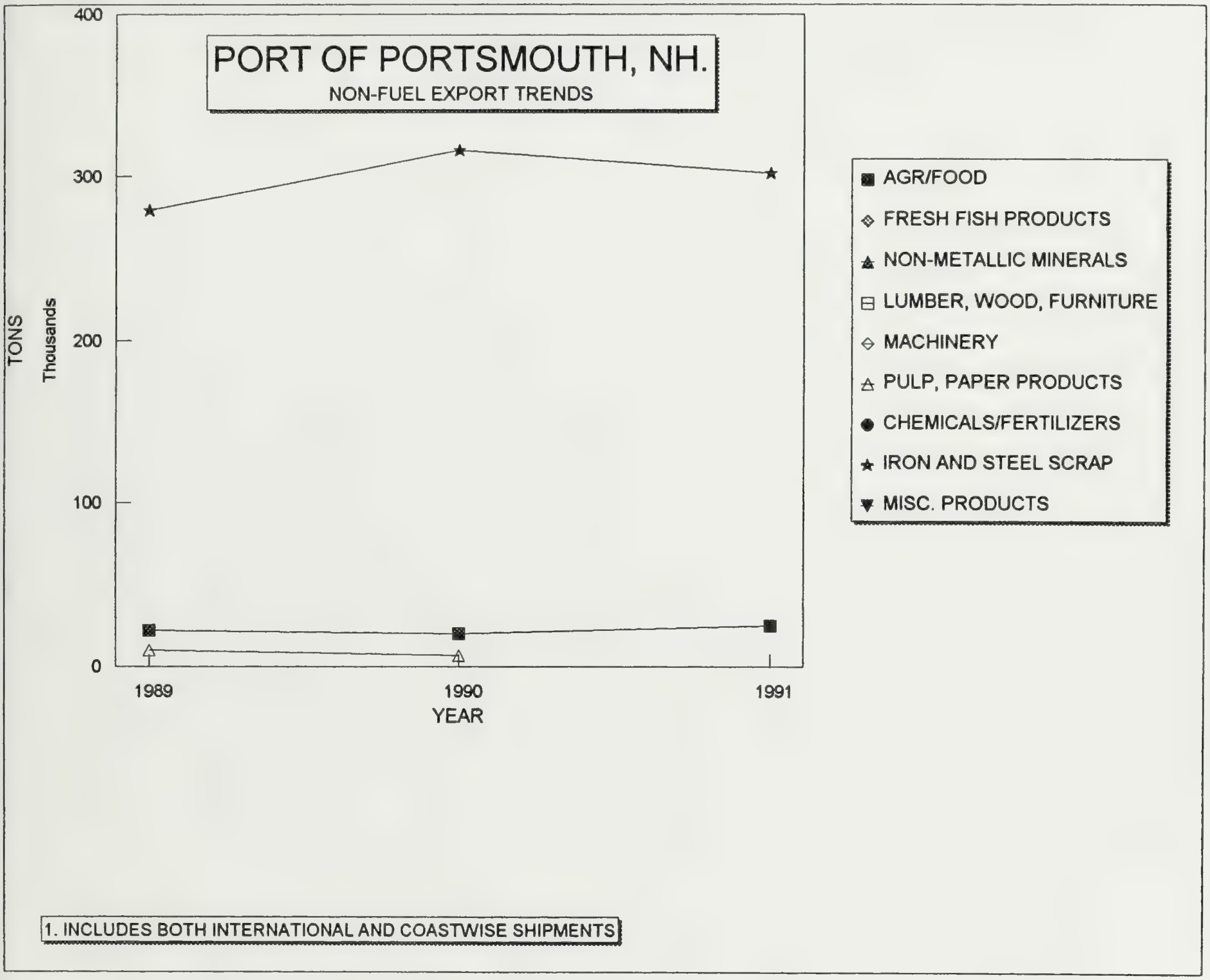
1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS
2. 1991 DATA NOT AVAILABLE. ESTIMATE USED.



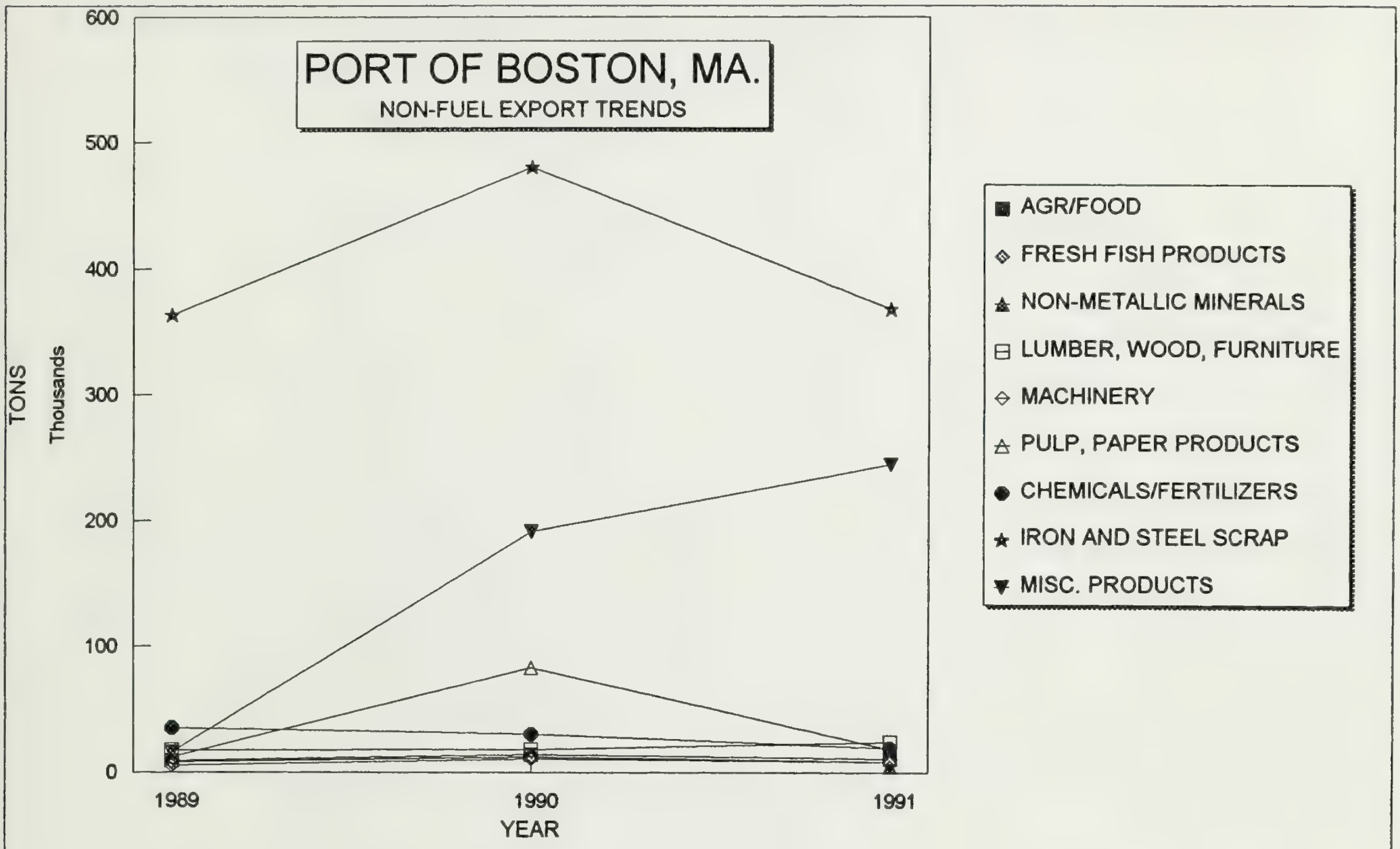
1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS



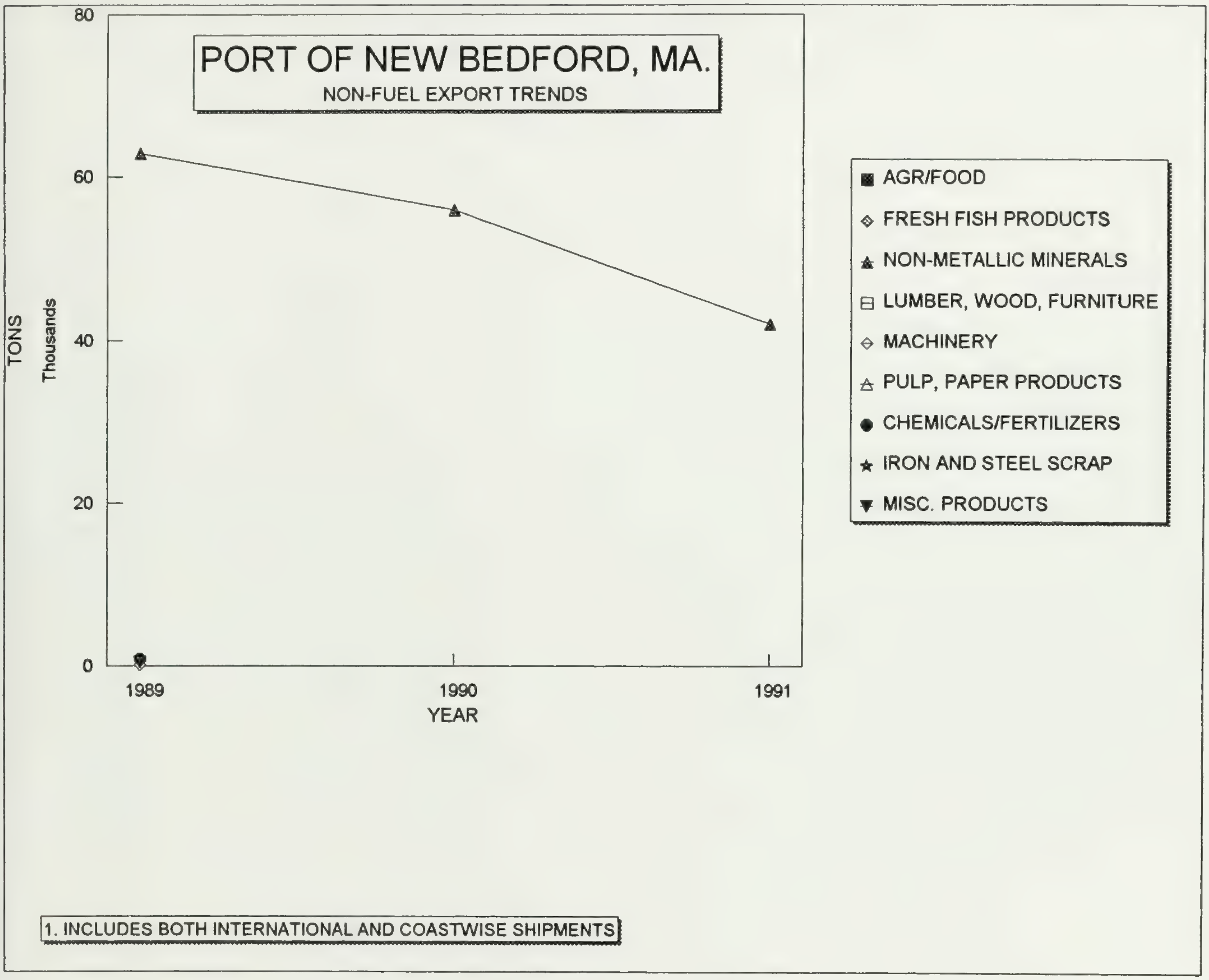
PORT OF PORTLAND, ME.
NON-FUEL EXPORT TRENDS
TONS
Thousands
80
60
40
20
0
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
MACHINERY
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
IRON AND STEEL SCRAP
MISC. PRODUCTS
1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS



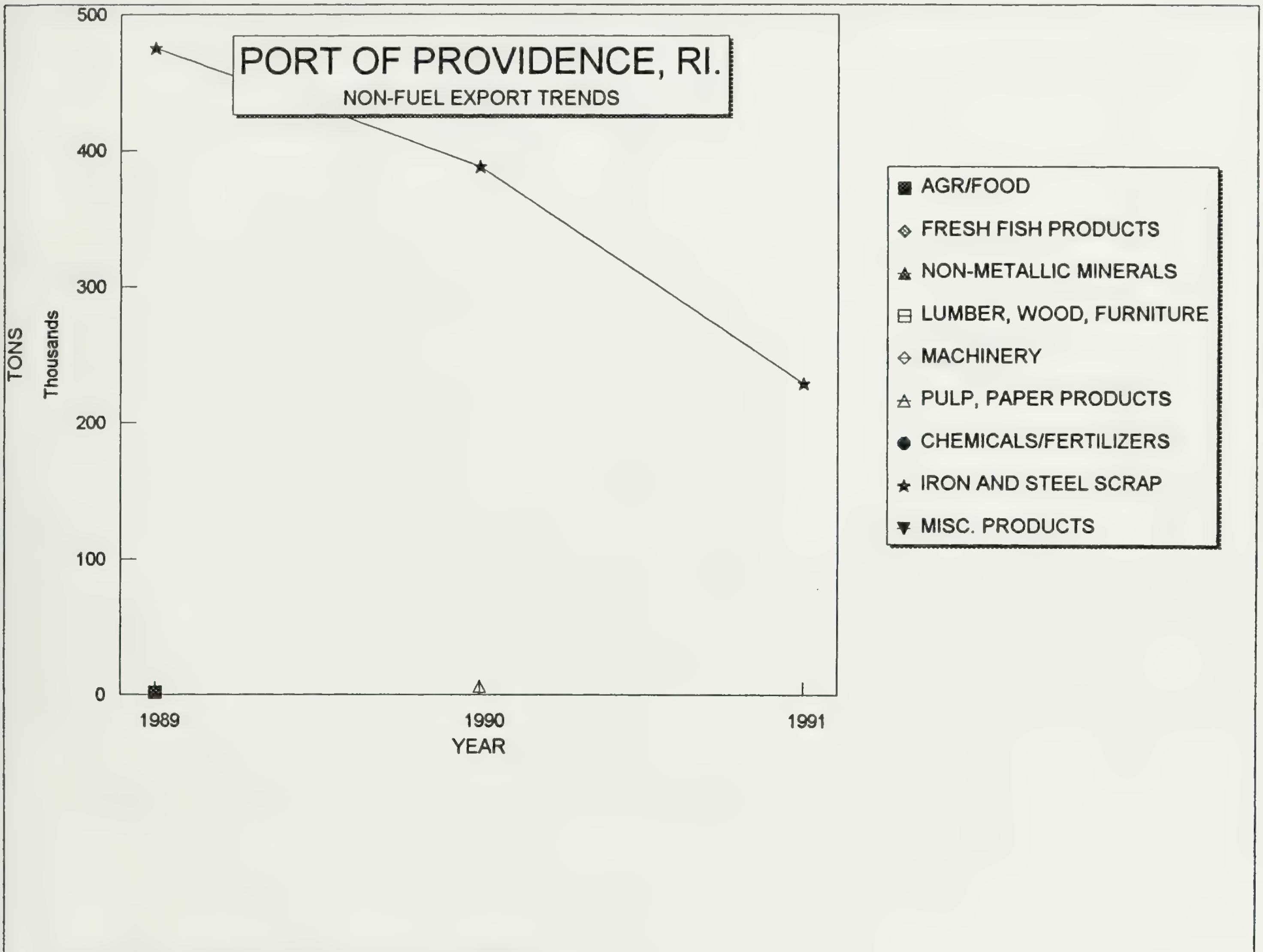
PORT OF PORTSMOUTH, NH.
NON-FUEL EXPORT TRENDS
TONS
Thousands
400
300
200
100
0
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
MACHINERY
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
IRON AND STEEL SCRAP
MISC. PRODUCTS
1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS



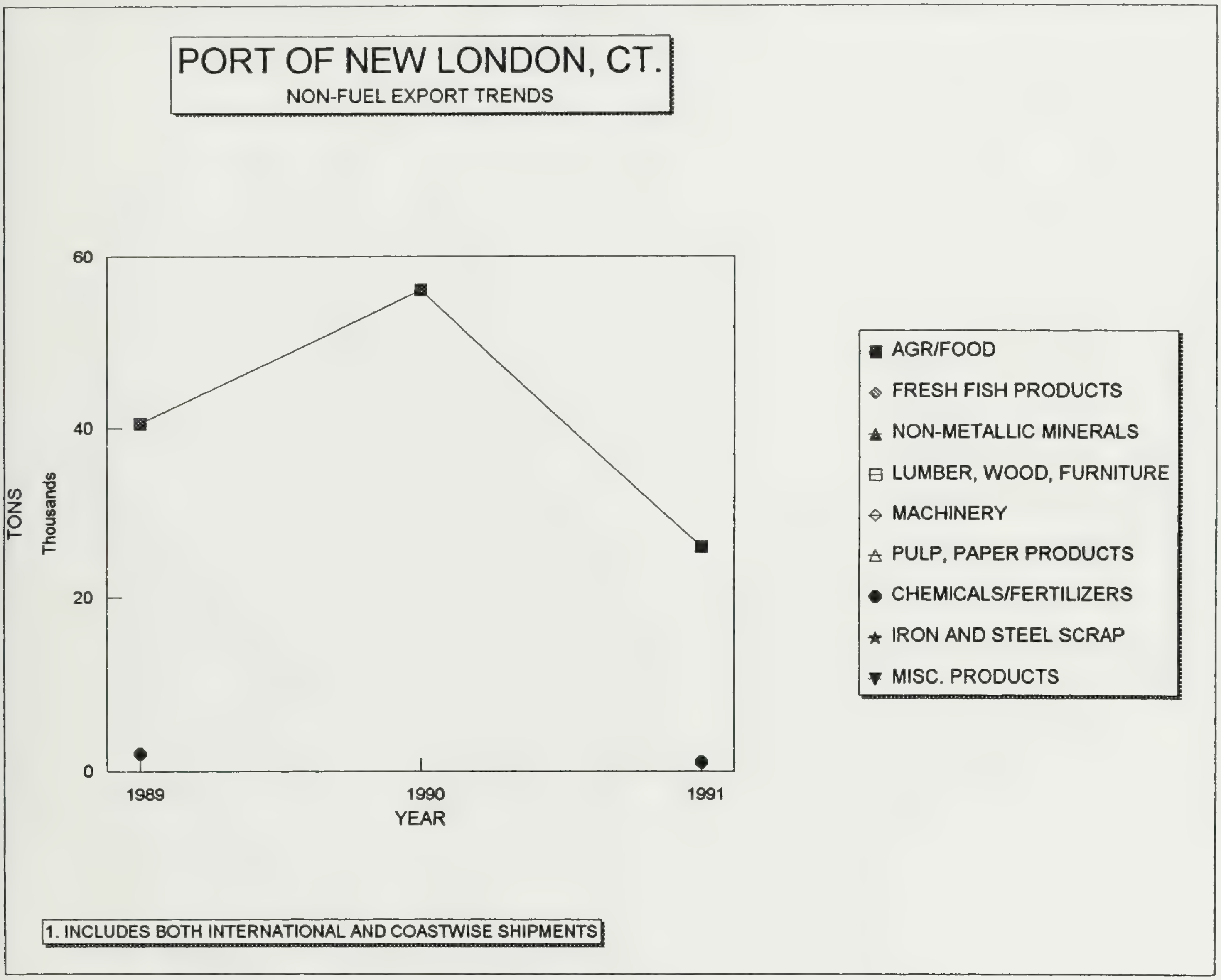
1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS

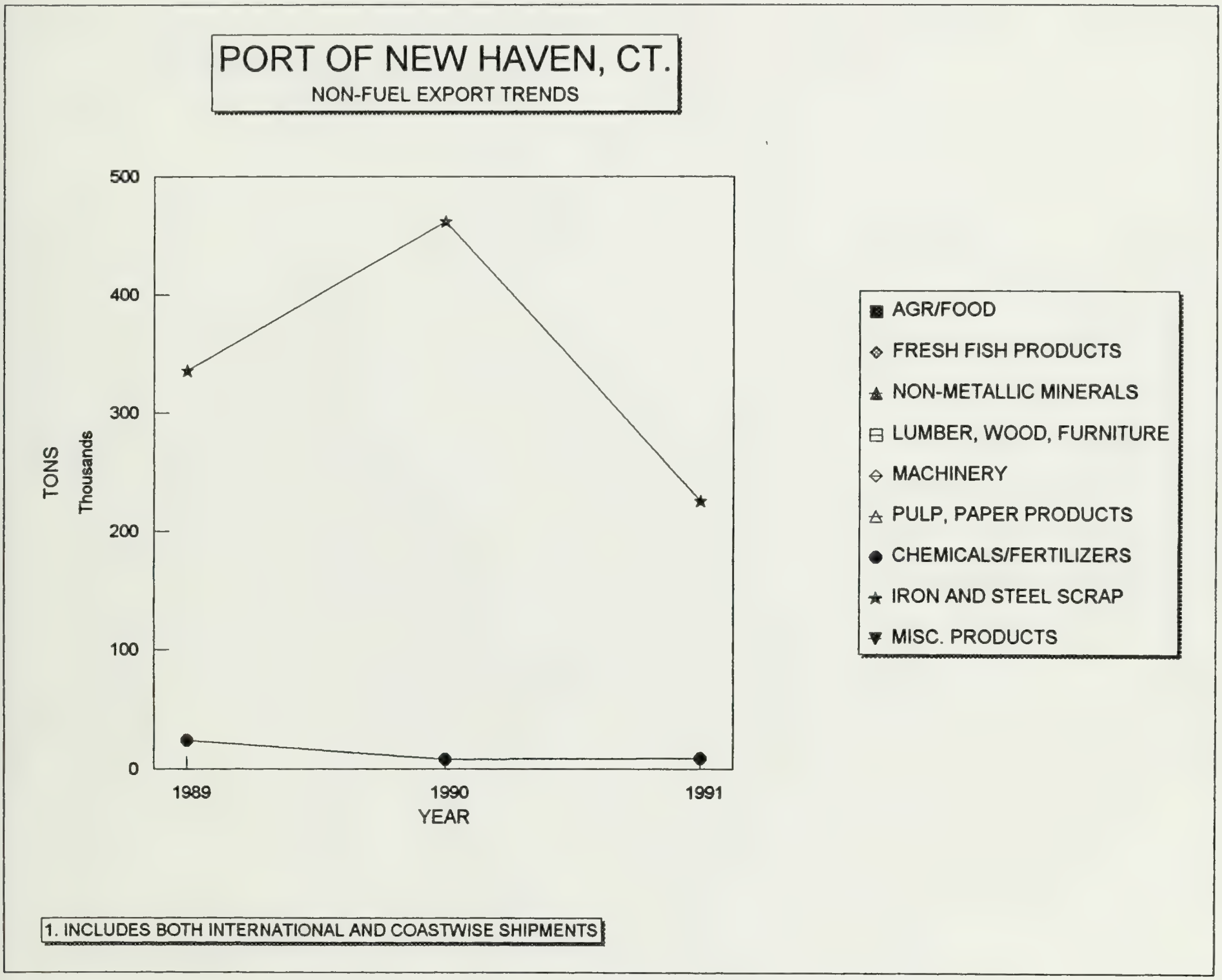


PORT OF NEW BEDFORD, MA.
NON-FUEL EXPORT TRENDS
80
60
40
20
0
TONS
Thousands
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
MACHINERY
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
IRON AND STEEL SCRAP
MISC. PRODUCTS
1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS

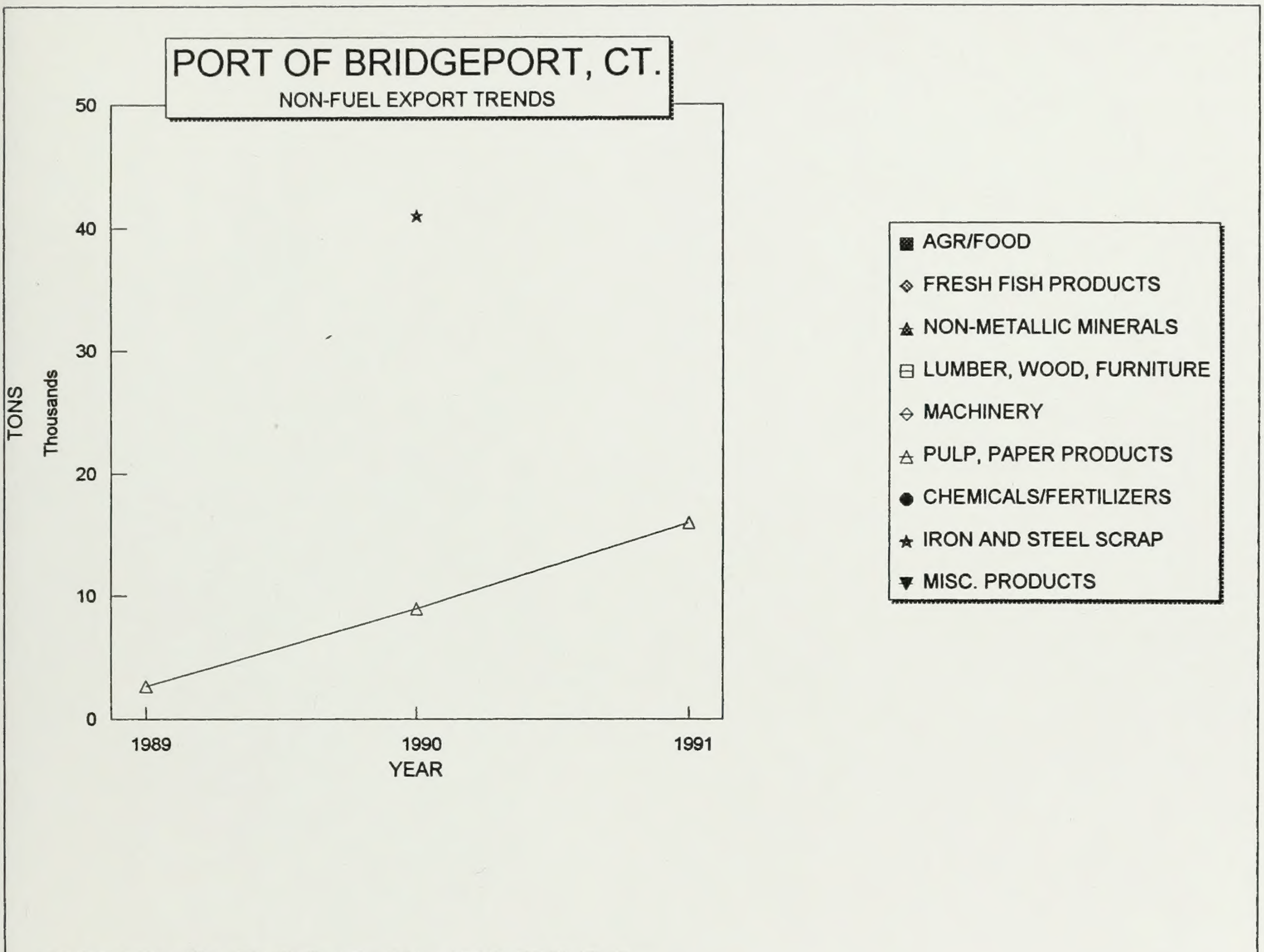


1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS


PORT OF NEW LONDON, CT.
NON-FUEL EXPORT TRENDS
TONS
Thousands
60
40
20
0
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
MACHINERY
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
IRON AND STEEL SCRAP
MISC. PRODUCTS
1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS



PORT OF NEW HAVEN, CT.
NON-FUEL EXPORT TRENDS
500
400
300
200
100
0
TONS
Thousands
1989
1990
1991
YEAR
AGR/FOOD
FRESH FISH PRODUCTS
NON-METALLIC MINERALS
LUMBER, WOOD, FURNITURE
MACHINERY
PULP, PAPER PRODUCTS
CHEMICALS/FERTILIZERS
IRON AND STEEL SCRAP
MISC. PRODUCTS
1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS



1. INCLUDES BOTH INTERNATIONAL AND COASTWISE SHIPMENTS